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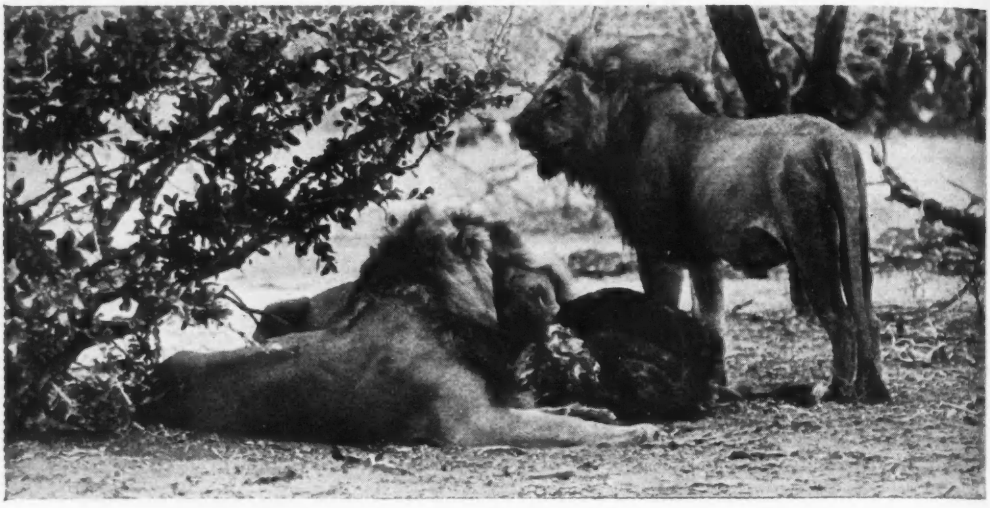

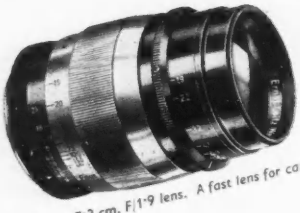

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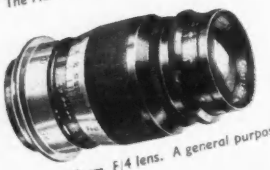

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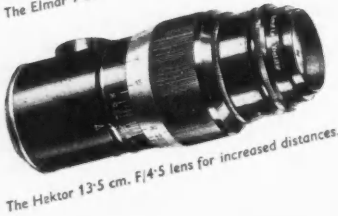

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DISCOVERY

AUGUST 1939 *New Series, Vol. II, No.* 17

Published by CAMBRIDGE UNIVERSITY PRESS, 200 Euston Road, N.W. 1 (Tel.: Euston 5451–3)
Editor: C. P. SNOW, University Press, Cambridge (Tel.: 4226)
Advertisement Offices: 61 Chandos Place, W.C. 2 (Tel.: Temple Bar 6008)
Annual Subscription, 12*s.* 6*d.* net post free
Sole agents in the U.S.A.: The Macmillan Company. Annual Subscription $4.00
Sole agents for South Africa: Central News Agency (London agents: Gordon & Gotch)
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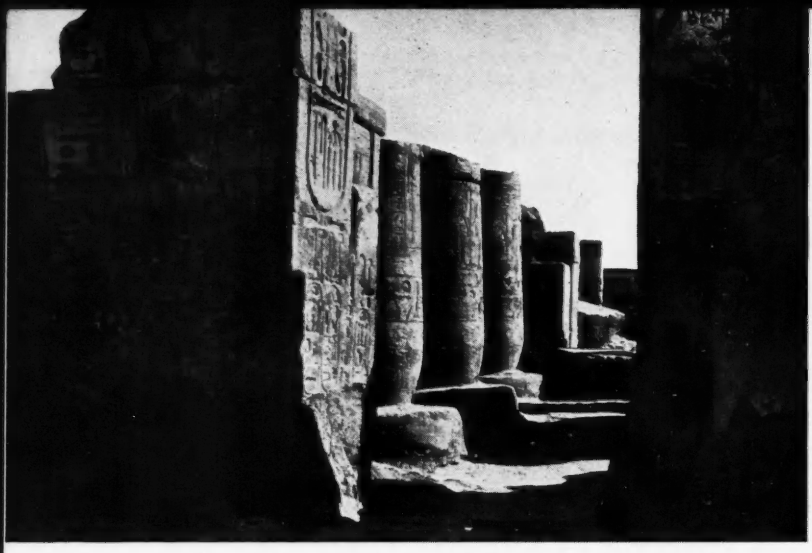
An Ancient Egyptian Frontier Town

By H. W. FAIRMAN

(Discovery *is fortunate to be able to publish the following account of the Egypt Exploration Society's recent work in the Sudan. Mr W. H. Fairman, who is an expert at Ptolemaic history, was himself leader of the expedition, and here gives a first-hand report of the excavations of the site at Amarah West, on the left bank of the Nile.*)

THE Egypt Exploration Society has just completed a most successful first season's work on an ancient Egyptian fortified town in the Northern Province of the Anglo-Egyptian Sudan. The site at Amarah West lies on the left bank of the Nile some 120 miles south of Wadi Halfa, in the desolate area that lies between the Second and Third Cataracts. The town occupies a small mound overlooking the river and consists of a brick enclosure about 150 yards square within which are a temple and magazines and dwelling houses. The settlement clearly spreads beyond these limits, and deeply buried house remains exist outside the protection of the main wall. On the high ground to the north lies the Egyptian cemetery of the New Kingdom, which merges with later cemeteries, and further extensive remains of a more recent date occupy a vast semicircle round the town. These later remains have not yet been examined, but appear to belong to a more or less unknown Sudanese culture.

The ancient town is completely buried under a deep accumulation of debris and wind-blown sand. When the work was started, not a single brick or stone wall was visible; all that could be seen were the great mound, a few potsherds and one enormous block of stone which proved to be one of the fallen roofing blocks of the

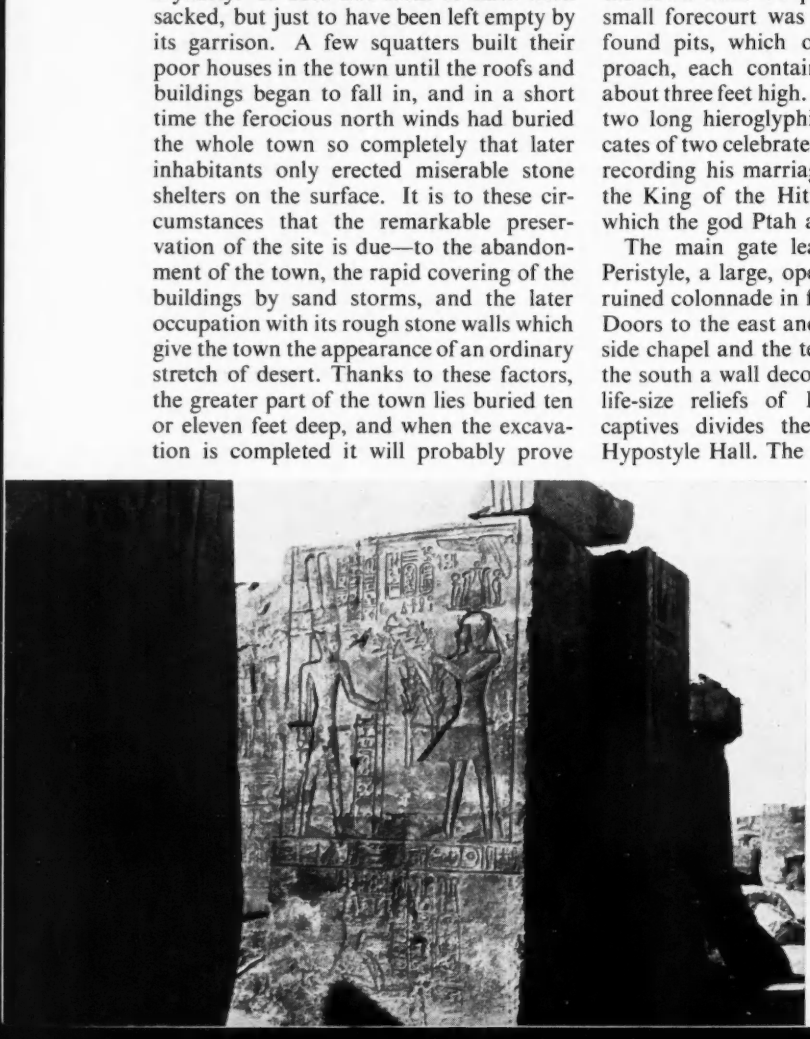


Amarah West: *View of the Hypostyle Hall from the north door*

temple. As far as can be judged at present the town was abandoned in the troublous and uncertain times after the XXth Egyptian Dynasty. It does not seem to have been sacked, but just to have been left empty by its garrison. A few squatters built their poor houses in the town until the roofs and buildings began to fall in, and in a short time the ferocious north winds had buried the whole town so completely that later inhabitants only erected miserable stone shelters on the surface. It is to these circumstances that the remarkable preservation of the site is due—to the abandonment of the town, the rapid covering of the buildings by sand storms, and the later occupation with its rough stone walls which give the town the appearance of an ordinary stretch of desert. Thanks to these factors, the greater part of the town lies buried ten or eleven feet deep, and when the excavation is completed it will probably prove to be the most complete and perfectly preserved town of Pharaonic Egypt that has been discovered.

The first season's work was occupied almost exclusively with the uncovering and recording of the temple, which lies in the north-east corner of the great brick enclosure. In its present form the temple is entered from the north, the side most remote from the river, by a monumental gateway cut through the town wall. To protect the entrance a small forecourt was built, and in it were found pits, which once flanked the approach, each containing stumps of trees about three feet high. Here also were found two long hieroglyphic inscriptions, duplicates of two celebrated texts of Ramesses II recording his marriage to the daughter of the King of the Hittites and a dream in which the god Ptah appeared to him.

The main gate leads directly into the Peristyle, a large, open court with a much ruined colonnade in front of its four walls. Doors to the east and west lead to a small side chapel and the temple magazines. On the south a wall decorated with more than life-size reliefs of Ramesses II smiting captives divides the Peristyle from the Hypostyle Hall. The entrance to the latter is through a great gate on whose jambs are exhortations to every entrant to be "very pure". On the west jamb, which would have been hidden in ancient times when the great wooden door was open, can be seen the private accounts of some doorkeeper,



West jamb of main door to Hypostyle. Ramesses II makes offering to Amur

View across style from east

who appe occupied moments his figur stonework temple.

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Beyond style lies a tibule lead Sanctuary consists of tuary itsel room cont stone base the boat-sh

The entran Hypostyle, through to Sanctuary

View across the Hypostyle from the south-east

who appears to have occupied his idle moments by cutting his figures in the stonework of the temple.

The Hypostyle consists of twelve columns still standing some ten or eleven feet high and which retain much of their original colour. On the east side the reliefs are of a formal and religious nature; on the west, however, they give details from the wars of Ramesses II, the most interesting section being that depicting the siege of a Syrian city whose walls are being undermined by sappers protected by a hoop-shaped construction. The importance of the Hypostyle, however, does not lie in its reliefs but in the lowest register of inscriptions, which preserves a list of the names of some 200 Syrian and Sudanese cities and peoples who had been conquered by or were tributary to Ramesses II. The study of these lists, which are the longest that have been found for many years, is not yet complete, but it is clear that it will have important results. Over half of the Syrian names have not been observed before, and interesting new identifications have been made, including the discovery of the name of Jericho for the first time in hieroglyphs, as well as such places as Babylonia, Carchemish, Joppa, Kadesh and Raphia, which are known from other texts.

Beyond the Hypostyle lies a small vestibule leading to the Sanctuary area. This consists of the Sanctuary itself, a small room containing the stone base on which the boat-shrine once rested, flanked by two small chambers and the stone stairway which led up to the roof. The reliefs of this portion of the temple are surprisingly good when it is considered that they formed part of the decoration of a comparatively small provincial garrison town and are superior to those in the majority of the Ramesside temples of Nubia. They show that even in the remotest corners of the Egyptian Empire there were skilled craftsmen who could produce work that rivalled the best of their time.

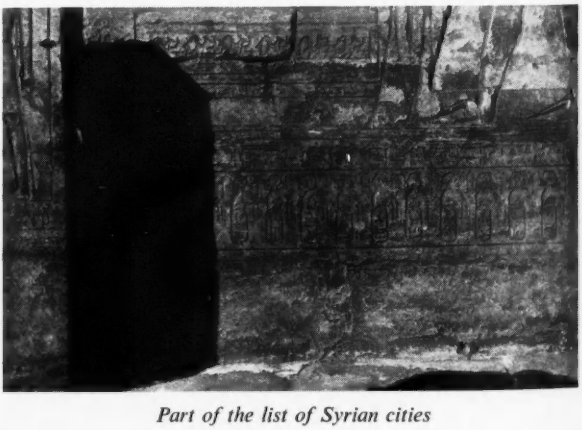
Such in brief is the present appearance of the temple. Obviously, it was quite different originally. When first planned neither the present entrance nor the Peristyle existed, and the original entrance was through what is now the Sanctuary. The temple seems to have been planned on a modest scale by Ramesses II, who then decided that it must assume a more imposing shape and the Peristyle was first added, to serve as

The entrance of the Hypostyle, looking through towards the Sanctuary

the Sanctuary. At the same time all the reliefs on the columns were obliterated and replaced by others which, though three or four times their size, are by no means as well executed. In the course of time the disfiguring plaster has fallen away, and the original figures have been exposed in all their charm and brilliant colouring. This, however, was but the initial stage in the reconstruction for, for some reason which is still unknown, Ramesses II decided to reorientate the temple. The original entrance on the south was blocked up, and the open court which must have existed was subdivided into the rooms of the present Sanctuary area; the old Sanctuary was pulled down and converted into the present Peristyle, its columns and foundations being largely built from the stones of the former building, and finally the town wall was breached, and an imposing gateway cut through it. The final result may have been more impressive than the original plan, but it was a bad error, for the temple now lay open to the north, the direction of the prevailing, boisterous and sand-laden wind, and this must have made it difficult to keep the building clean, and was the chief factor in its speedy burial and preservation until to-day.

The stump of an ancient tree, one of those which flanked the approach to the temple

The present temple was largely the work of Ramesses II, but his enterprise was continued by his successors, and the decoration does not seem to have been completed until the sixth year of Ramesses IX. The building of the temple therefore occupied about 140 years. There may have been an even earlier temple on the site, for it is now certain that a town existed at this spot in the reign of Seti I, father of Ramesses II, and it is not impossible that the town was founded in the middle of the XVIIIth Dynasty, in the reigns of Hatshepsut and Tuthmosis III. Definite traces of an earlier town have been found, and one of the tasks of future excavation will be to follow them up.



Part of the list of Syrian cities

The general results of the expedition have been equally satisfactory. Apart from two pieces of statuary and the usual scarabs

One of the columns in the Hypostyle, showing the two periods of working. The small figures are the earlier

and objects in faience and metal, the chief finds have been a series of seven hieroglyphic stelae from four to six feet high, the earliest being a magnificent stela of

Fragment of the top of a stela of Sethos I, who is smiting negro captives

Amenophis II of the XVIIIth Dynasty. Some of these texts are dated and refer to viceroys of Ethiopia. As a result of the excavations three hitherto unknown viceroys of Ethiopia have been discovered, and much additional information has been obtained concerning others. In addition, sherds of the newly discovered "Saharan" civilization have been found, and it is thought likely that future work will reveal another new culture. Within the last few years "Saharan" sherds have been found in Egypt and in various parts of the Sahara as far east as Selima Oasis. It has been suspected, therefore, that the Saharan people entered Egypt from the south, coming originally via Selima Oasis from some centre farther west in the Sahara. The significance of the discovery at Amarah West lies in the fact that we have probably found the first place in the Nile valley to be reached by these invaders, for Amarah lies at one end of the shortest route between the Nile and Selima, a route used to this day by the local Arabs who regularly visit Selima (the journey takes only three days) in order to obtain salt.

It is pertinent to enquire what was the importance of Amarah West in the Egyptian Empire in the Sudan. The activities of the Egyptians in the Sudan fall roughly into two periods. The first period began in the Pyramid Age when caravans are known to have pushed beyond the southern boundary of Egypt and a few trading posts were set up. These posts were transformed into fortresses during the Middle Kingdom (2000–1788 B.C.), the most famous being those between Buhen (Wadi Halfa) and Semneh in the Second Cataract district. These forts served not merely to hold back the wild nomad tribes but also to guard the

Coloured stela of Ramesses II which records the official name of the ancient town

Stela of Setnakht and the viceroy of Ethiopia, Hori, son of Kama

Stela of the fifth year of Ramesses III. The titulary of the king, and praises of him by the viceroy of Ethiopia, Hori

traders' convoys, for all ships were compelled by the cataracts to unload at either Buhen or Semneh. After the end of the Middle Kingdom and during the resultant chaos in Egypt a lull ensued, but after the rise of the XVIIIth Dynasty (1580 B.C.) a forward policy was resumed, and a further series of forts was built, especially in the district between the Second and Third Cataracts. These forts were undoubtedly designed to serve the same purpose as their predecessors, but it is equally clear that the threat of invasion was now very small and that the country was completely under Egyptian control. As a result of this, the new constructions were no longer built in strategic positions, and though they retained the outward form of fortified towns, their fortifications were more for show and could hardly have resisted or have been intended to resist serious attack. It is to this second period of Egyptian imperial effort that Amarah West belongs.

A most interesting fact has, however, emerged which may throw light on the choice of Amarah West as the site of a new fort. It will be recalled that it has been pointed out that though the town lies on the left bank of the river, the entrance to the temple lies on the side most remote from the Nile and facing the desert. Moreover, there is no gate in the wall on the river side of the town. This is a most extraordinary state of affairs if the town were intended to exert any control over the river. The probable explanation is that since the town was founded the river has completely changed its course, and that when it was built it lay either on the right bank of the river or, more probably, on an island. If this is correct, then it appears that the main navigable channel lay between the temple

and the high ground to the north on which the cemeteries were situated, and that very probably there were rapids on the south side, now the main bed of the river; a mysterious construction just to the north of the temple may well be, in fact, the remains of the landing stage of the town. The harbour would have been open to the north winds, but Amarah itself would have fulfilled a definite strategic purpose, for all river-borne traffic would have been compelled to have passed close to the town before attempting to shoot the minor cataract of Ginnis a few miles to the north.

So far only a fraction of the site has been examined, but the results have been of outstanding importance. There is every reason to expect that the result of future work will be every bit as good. In no one direction can it be said that the possibilities of the site have been exhausted; they have hardly been assessed as yet, and all the indications show that the work of coming seasons will not only yield antiquities but results of the highest archaeological, architectural and historical importance.

The Riddle of *Bonellia*

By Dr WIKTOR W. NOWIŃSKI

(Bonellia *is a creature which shows some of the oddest sexual behaviour known to zoologists. In this article Dr Nowiński gives a brilliant account of the remarkable facts.*)

WHEN in 1818 the Italian zoologist Rolando described a worm which he had just discovered and named it *Bonellia viridis* after his friend Bonelli, he probably did not realize that about 120 years later this worm would become world famous. There is scarcely a biology text-book now, in which *Bonellia* is not mentioned. How did this happen and why is *Bonellia* so famous?

Rolando described the female of the species, a rather curious-looking worm: it possesses a body with organs (gut, ovaries, uterus, etc.) of the shape and size of a walnut, and a proboscis about a yard long. It lives in the Mediterranean, especially on the coast near Naples and Banyuls (France), on the bottom of the sea about eight yards from the surface, among tuff stones; the body lies in a hole in the stone and only the proboscis projects out of the hole and moves around (Fig. 1). This proboscis is not only a sense organ (adult *Bonellia* has no eyes), but also collects food in the form of tiny particles of microscopic plants and animals and brings them by peristaltic movements into the mouth.

The trouble with *Bonellia* started in the first years after its discovery. In his paper Rolando described a female only, and though he was very anxious to find the male of *Bonellia*, he did not succeed. Some other zoologists tried to find the male partner too, but with the same bad luck. Only about 50 years after *Bonellia* was discovered, the Russian zoologist, A. A. Kowalewski, to whom modern zoology is very much indebted for his excellent researches in various fields, published a paper in which he claimed to have discovered the male of *Bonellia viridis*. The whole story of this discovery sounded so fantastic that many contemporary biologists would not believe it.

It was known to almost every scientist who dissected *Bonellia* that in the foregut

Fig. 1. Bonellia *on the bottom of the sea. (After Baltzer, unpublished.)*

Bonellia *lives in tuff stones, about* 8 *yards under the surface. The trunk lies in a hole of a tuff stone, but the proboscis projects out of the hole and collects food.*

of the female live parasites, little worms of about $\frac{1}{8}$ inch, or less, very rudimentary in their appearance and resembling the parasites which the zoologists called Nematodes. Kowalewski said that these little creatures in the gut and sexual organs of *Bonellia* are the males which so many investigators were fruitlessly looking for (Fig. 2). It was hardly believable that these parasites, in appearance like a comma, were the males of *Bonellia*, though there were known very many cases of sexual dimorphism, or morphological differences between the female and the male of the same species. Nevertheless, in the case of *Bonellia* we had to deal with an extreme example of this phenomenon. But this sexual dimorphism was only the beginning of a series of very surprising phenomena in *Bonellia*.

In 1879 the German zoologist Spengel published some more extraordinary facts about *Bonellia*. He was anxious to investigate its embryonic development and to find out how this sexual dimorphism developed. Very careful investigations have proved without any doubt that the female lays eggs in long strings, covered with jelly, and that from these eggs develop tiny barrel-shaped larvae, about $\frac{1}{8}$ inch in size. These larvae, owing to two rings of long ciliae and a covering of smaller ciliae all over the body, swim

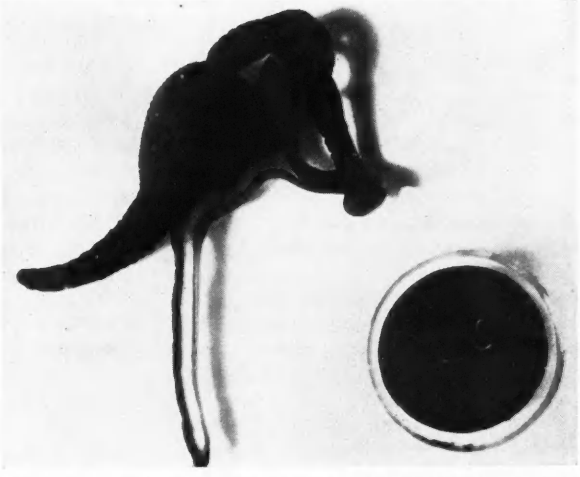


Fig. 2. *An adult female of* Bonellia viridis *and males. (After Baltzer, unpublished.)*

Bonellia *possesses the extreme case of sexual dimorphism: the female has a trunk as big as a walnut and a proboscis a yard long. The males (in the dish) are small worms about* $\frac{1}{2}$ *inch long.*

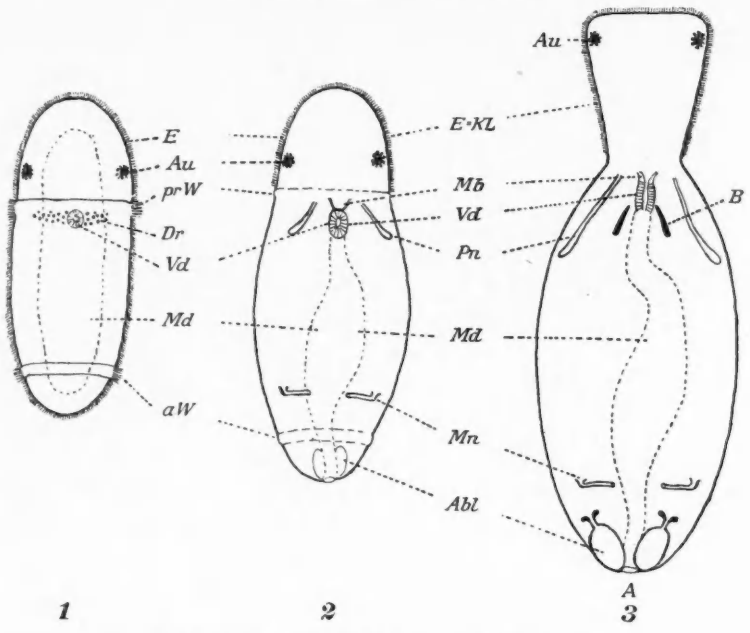


Fig. 3. Development of a female. (After Baltzer.)

The figure on the left is an indifferent larva. If it lives free in water it develops into a female and the indifferent organs of the larva become typical organs of a female (in the middle and on the right). The blastopore vesicle (Vd) becomes a foregut, the anal vesicles (excretory organs, Abl) develop, and a pair of bristles (B) is visible. The larva has a pair of eyes, which disappear in the course of development. Note also the existence of hindgut (between the anal vesicles).

freely in water, and some settle on the proboscis of an adult female. The former larvae, which remain free, develop into females, but those which parasitize develop into males, and after 100 hours of such parasitism, creep into the foregut of the female.

Though these results of Spengel's investigations were exceedingly interesting and would even to-day be a first-class scoop for every scientific correspondent of any daily paper, they were soon forgotten. The time was not yet ripe to understand the importance of these processes: in the second half of the last century, zoologists were too busy with purely morphological investigations, and tried to enrich the theory of evolution with as many facts as possible, while many physiological facts, which are now part of the common knowledge of science, were unknown then. Thus it happened that in about 1910 the problem of *Bonellia* was rediscovered for biology by the eminent Swiss zoologist, Baltzer.

Baltzer was working at the Zoological Station in Naples on a monograph of the group of marine worms called Echiurida to which *Bonellia* belongs. Reading the papers by Kowalewski and Spengel, he at once realized that the process of sex determination in *Bonellia* might be very important to modern biology, and that these problems were worthy of being investigated more carefully and from modern points of view. There were then two important branches of biology arising. The one was the modern

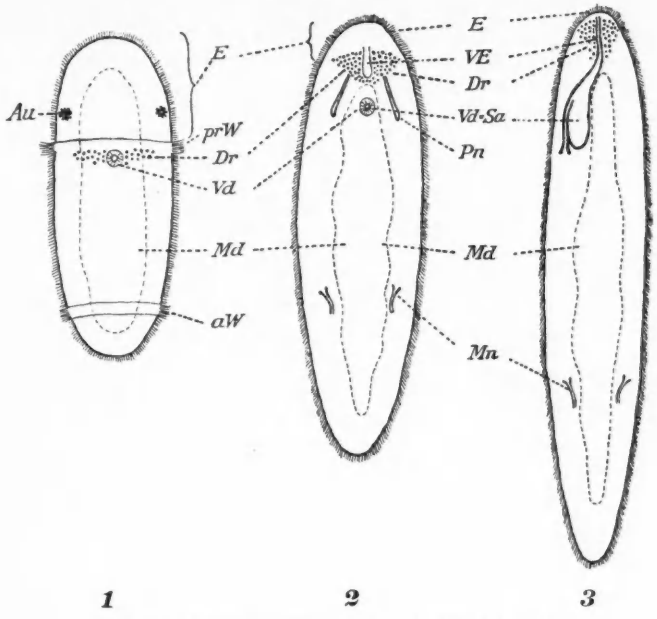


Fig. 4. Development of a male. (After Baltzer.)

If an indifferent larva (on the left) fixes on the proboscis of an adult female, it develops into a male (centre and on the right). The same indifferent organs of the larva possess therefore the tendency of developing either a female or a male organ. Note the elongated shape of the male. The blastopore vesicle (Vd) of the larva becomes the spermatheca, where spermatozoa are collected from the cavity of the body. Here there are no bristles, no hindgut and no foregut.

theory of inheritance or genetics, which brought so many important theoretical and practical results to our knowledge; the other was the problem of hormones, or substances originating in a special gland in one part of the body, and which, carried by the blood, influence organs in other parts of the body; these are apparently without any direct connexion with the gland. The discovery of these glands was very important for our knowledge of the development and function of animal bodies.

Baltzer wanted to investigate whether in *Bonellia* a substance spreads from the proboscis of a female into the parasitizing larva and determines its sex. If it were really so, then a larva which just settled on the proboscis and was immediately washed away and kept free in a dish would develop into a female. The experiment confirmed this assumption and also produced one even more astonishing fact: if the larvae parasitizing during a period of about 100 hours are then washed away from the proboscis and cultivated in a dish, they develop into males; but if the larvae are washed away earlier, a series of intersexual individuals develop, having both female and male characteristics mixed up. The shorter the period of parasitism, the fewer male characters have the intersexual larvae, and the longer the parasitism, the more male become the larvae.

There is one important fact to note: the larvae, as I said, have no sex; they are indifferent, i.e. their organs are neither male nor female organs, but are larval organs. If the larva lives free in water, the

larval organs differentiate into female organs (foregut, hindgut, uterus, ovaries and so on), but in a parasitizing larva and under the influence of the proboscis substance the same larval organs may develop into pure male organs (spermatheca, spermaduct, etc.). This is clearly shown in Figs. 3 and 4.

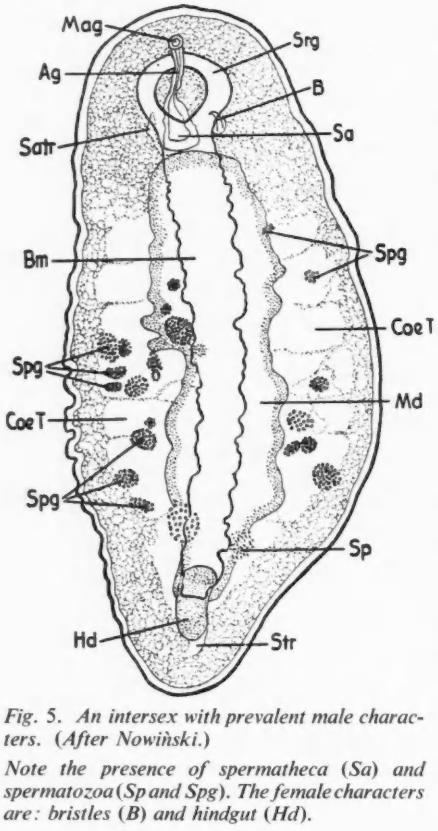


Fig. 5. An intersex with prevalent male characters. (After Nowiński.)

Note the presence of spermatheca (Sa) and spermatozoa (Sp and Spg). The female characters are: bristles (B) and hindgut (Hd).

We say that a larva has double potencies, and according to the circumstances develops in one or another direction. The reactions of these larval organs towards the proboscis substance are very different: some react quicker and some react slower. This was shown on the intersexual individuals; if the larvae were washed from the proboscis a very short time after fixation, their appearance in the course of development is purely female, but they have already the capacity of producing spermatozoa. This means that only a very short stimulus is necessary to produce the spermatozoa. On the other hand, in strong male-like intersexes which were washed away after about 80 hours of parasitism, two typical female organs still develop: two bristles and the hindgut (Fig. 5). These two organs obviously require a still longer influence of the proboscis substance to be completely suppressed.

It is necessary to add that a male completes its development in 100 hours, whereas it takes two years for the female to reach the stage of sexual maturity.

For a better understanding of these facts, it is necessary to know how the substance spreads through the body of a parasitizing larva. Fig. 6 shows a microscopical section through a parasitizing larva together with a part of the proboscis; the larva is attached only at one particular part of the body, and it is interesting to note that this part is particularly rich in glands. We do not know at the moment which role they play; they may produce a kind of mucus, which acts as an adhesive, but there may also be a way through which the substance passes from the body of the female into the body of the larva; and it is possible that they have both functions at the same time. Fig. 7 shows a larva in a later stage of parasitism: the differentiation in the direction of a male is still proceeding, as is obvious from the elongated shape of the larva, characteristic for the male.

What kind of substance is it that spreads into the larva? We do not know very much about it, but there is some evidence that it is a substance with definite chemical properties. If the gut of an adult female, which contains also the active substance (even the gut juice has the same properties), is extracted first with acetone, then the remaining gut tissue is dried and extracted with distilled water, two extracts are obtained. Indifferent larvae cultivated in

the acetone extract (diluted with sea water) develop into normal females, but in the water extract the majority become males. We may therefore assume that this *Bonellia* substance is water-soluble. We know also that it is heat-stable, because cooked extracts do not lose their activity.

How does this *Bonellia* substance act? This again is a very difficult question to answer, and before discussing it let us have a look at the question of *Bonellia* from a different angle.

We know to-day that sex determination is strictly connected with the process of heredity, and the sex of the individual is laid down in the moment of fertilization, when the nucleus of the egg fuses with the nucleus of the spermatozoon. There are genes in the chromosomes which produce substances responsible for the determination of sex. Let us take a concrete example: the female of the fruit-fly *Drosophila* has four pairs of chromosomes of which one pair is called *XX*-chromosomes, and these two chromosomes are the real sex chromosomes (i.e. connected with sex determination); the male has three pairs of chromosomes (somatic), just as the female, but the fourth pair consists of one *X*-chromosome and one *Y*-chromosome. We assume that these *X*-chromosomes produce substances (or substance) which we call *FF* substances; the analogous male substances, the *MM* substances, are produced in the somatic chromosomes. If, as in the case of *Drosophila*, the *FF* substance is stronger than the *MM* substance, a female develops; but the *MM* substance is stronger than one *F* only, and this chromosomal combination is responsible for the development of a male; the male has one *X* only (the *Y*-chromosome does not play any role in this process).

In the case of *Bonellia* there is probably not such a strong difference between the *FF* and *MM* substance as in *Drosophila*, and the *FF* substance is just a little stronger than the *MM* substance; but if the larva fixes on the proboscis of an adult female, the proboscis substance acts on the chromosomes and stimulates the production of *MM* substance, which becomes stronger than the *FF* substance. It is like a juggler balancing a rod on his forehead: if there is no wind the rod does not fall, but if the wind blows the rod gets out of balance.

This explanation is of course purely hypothetical, because we do not even know what the chromosomes of *Bonellia* look like, and as it is very difficult to breed *Bonellia* in the laboratory, it is almost impossible to make any crossing experiments, necessary for proving this hypo-

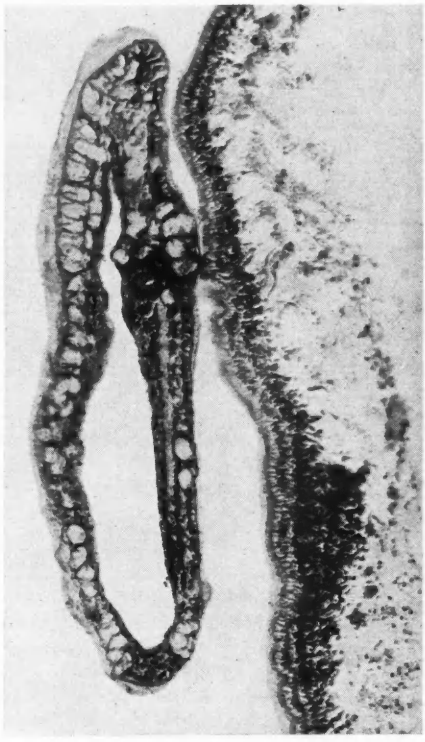


Fig. 6. A microscopical section through a proboscis with a parasitizing larva. (After Baltzer.)

Left the larva, right a piece of proboscis. This is an early stage of parasitism, the shape of the larva is not yet elongated. Note dark spots on the right side of the larva in the region of fixation: these are the glands.

thesis. But we have some indirect hints towards the existence of a chromosomal influence upon the sex determination in *Bonellia*; if we take twenty larvae, let them parasitize on the proboscis for 20 hours for instance, wash them away and cultivate in a dish of ordinary sea water, a series of intersexes develop. Not all the individuals, however, will be at the same degree of intersexuality; some will have more male characteristics and others more female characteristics. As the external conditions were exactly the same, we must assume that some internal forces were at work of which the chromosomal mechanism is always the most important. Extensive observations of developing larvae in dishes showed that even under these circumstances very few larvae develop into males, and these males are assumed to be the "genetic" males. There must exist also "genetic" females, which would develop in any circumstances into females and which probably do not possess the tendency of fixing on the proboscis at all. But the vast majority of larvae is of an indifferent type.

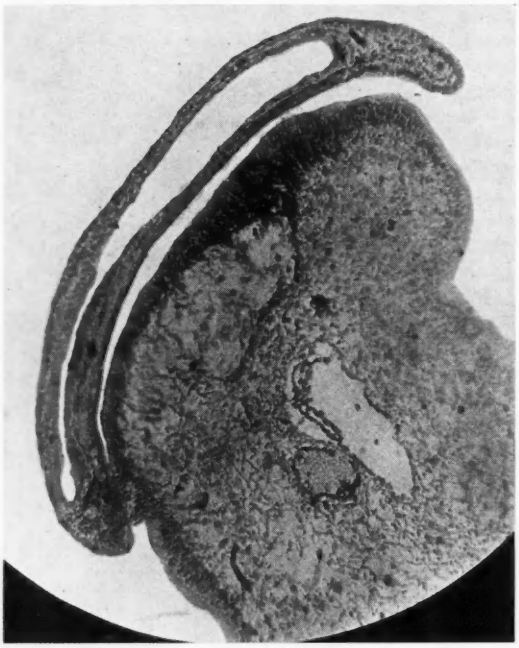


Fig. 7. A parasitizing larva in a later stage of development. (After Baltzer.) On the left the larva, on the right the proboscis. Note the already elongated shape of the larva.

The balance between *MM* and *FF* substances in *Bonellia* is very easy to alter even with other methods than with the proboscis substance. For instance, a slight acidification of sea water in a dish in which indifferent larvae are living stimulates the development of males, and even a longer shaking of them has the same effect. But these are all artificial conditions which do not occur in nature, and the only real way of sex determination in *Bonellia* is, of course, due to the influence of the proboscis substance spreading from the proboscis into the parasitizing larvae.

And now one question more: Why did *Bonellia* become so famous? It was pointed out that in almost all living multicellular organisms, whether plants or animals, sex determination takes place during the fertilization (genetic sex determination). In *Bonellia* we have a classical example of the very rare case of metagamic sex determination, i.e. determination which takes place in later stages of development and which is due to external influences. These exceptions are of great value to the scientist, because he tries to prove his theories by studying them, and such a study of exceptions often leads to the discovery of a general rule.

In the case of *Bonellia* the metagamic sex determination developed during millions of years of steady evolution and adaptation. Why is it that ages ago *Bonellia* started a path in sex determination so completely different from other organisms? This question we cannot answer: it is more than a riddle of *Bonellia*; it is a riddle of Nature.*

* The author wishes to express his gratitude to Professor F. Baltzer, Berne, for sending him photographs and drawings of *Bonellia*.

Plants Without Soil

By Dr C. H. WADDINGTON

EVER since man gave up a nomadic huntsman's existence, and settled down in one place, he has depended for his food on the skill of the farmer in making use of the fertile earth and the warm sunshine. In the last few years, certain branches of agriculture have been experimenting with methods which do away with one of these two aboriginal helpers; plants can be grown without soil by supplying the necessary nutriments directly to their roots. These methods have in some cases been very successful, and there are quite a number of commercial growers of fruit and vegetables who do not any longer come under the heading of "cultivators of the soil". The refinements of the method are mainly due to American initiative, and the greenhouses which are shown in the illustrations to this article were situated just outside Los Angeles.

The basic scientific principle is an old one, since it has been known for many years that plants can be grown in sand which is moistened with solutions of the appropriate salts. It was not so easy, however, to discover exactly the right mixtures for obtaining maximum growth and yield, but by now adequate formulae are available. The main elements which are required by plants, and absorbed by them through their roots, are nitrogen, potassium, phosphorus, calcium, magnesium and sulphur. The nitrogen can be supplied as ammonia, or, better, as nitrate, and the phosphorus and sulphur are usually given as phosphate and sulphate. Plants are comparatively tolerant things and will grow to some extent even if there are considerable deficiencies or excesses of some of these elements, but the best growth requires that they should be present in carefully balanced amounts, and as the salts are brought into immediate contact with the roots by the solution which circulates over them, variations in concentration are more important than they are in soil cultivation. On the other hand, they are very much easier to control.

In addition to these main elements, certain others are needed in minute traces. For instance, very small quantities of iron are essential for the formation of chlorophyll, the green colouring matter which alone enables the leaves to harness the energy of sunlight. It is also found that traces of manganese, boron, zinc, and copper can cause increased and more healthy growth, but it is still quite unknown how they act. They are required in concentrations of about 1 part in a million or even less; and in excess they may be very poisonous, so that the cultivation is usually not done in metal trays. Similar trace elements may be important for animal life. For instance, it has been shown that a certain disease of sheep in Australia is due to a lack of minute quantities of cobalt which are included in a normal diet.

It is rather difficult to check the presence of minute traces of elements in animal diets, but in plants all the necessary inorganic materials have probably been discovered by now. On the other hand, we are only beginning to suspect that certain organic compounds may be very beneficial in small doses, at least at certain stages of growth. The vitamins which animals take from their plant food are in fact probably not made merely for fun by the plants, but in some cases certainly play an important role in the plant's economy. Vitamin B_2, for instance, is a strong stimulant of root growth. But on the whole plants seem to be able to manufacture these substances themselves, if given a chance, and it is usually unnecessary to supply them with artificial vitamins, though this may be useful for special purposes such as inducing root growth on cuttings.

With the present techniques of soilless cultivation, extremely good growth can be obtained. Probably the best soilless-grown

Fig. 1. Young tomato plants growing in coarse sand. The nutritive solution is fed in through the pipes on the left.

plants are no better than the very best ones grown in soil; but if there is any doubt, it is on the side of the soilless ones. The main advantages claimed for the soilless method are the regularity with which such good results can be obtained, and the cutting down of labour by eliminating tedious tasks such as weeding.

There are several methods in use for feeding the nutritive solution to the roots. In all of them it is essential to see that the roots are not only washed by the solution but also have a supply of oxygen, since roots, like any other living things, must breathe. The simplest method is to set the plants in sterilized sand or cinders, and allow the solution to drip through this and run out into a trough at the bottom where it is collected and pumped through the system again. This is the easiest method to use on a small scale, for instance, for growing one or two plants indoors. The solution must of course be renewed from time to time as it becomes exhausted; actually it will be found that at first it tends to become too concentrated, since the plants absorb water faster than salts. A slight modification of this method is to flood the whole layer of sand occasionally, then to let the solution drain off and the sand to stand and dry for an hour or two before being flooded again.

In the most completely soilless method, even sand is dispensed with, and the plants are simply suspended so that their roots dip down into the solution, which is circulated through large shallow tanks. Some support for the stem is necessary, of course, and is usually provided by packing the plants into wire trays with some soft packing material such as straw. They can be packed quite close together, since the nourishment available to them is not dictated by the amount of soil which their roots can reach, but by the rapidity of the circulation of the solution. The only check on the number of plants which can be got into a given area is the necessity that they shall be able to get sufficient light. The possibility of close packing is of course of considerable

Fig. 2. The end of a solution-trough, to show how the tray containing sand is suspended over a trough in which the solution collects. Notice that the trough is made of wood, so that harmful metals cannot be given off into the solution. At the end of the trough is a pipe through which the solution is returned to the pumping station.

Fig. 3. Plants grown in pots of sand or cinders, over which solution is occasionally poured by hand.

economic importance, since it means a saving in expensive space, particularly for greenhouse crops which are the most likely to be grown in soilless cultures.

The large-scale use of water culture has only been carried out for a few years, and it would be rash to prophesy what it will develop into. It is one of the most striking new techniques which has been elaborated by biology, and some people have perhaps made exaggerated claims for it. It is very unlikely that the main food crops of the world will ever be grown in soilless cultures. But it seems very probable that the soilless method will be extremely valuable for specialized and hothouse crops, such as flowers, tomatoes, salads, etc. It may invade the whole field of market gardening, where the advantages of dependability and ease of operation would be most important. There is already some possibility, by manipulating the quantity of nutriment, of influencing the time of ripening of the crop, and if this can be further developed, it will be of the greatest importance.

Experiments on soilless cultivation are very easy to make. All that is necessary for small-scale cultivation is an opaque pot for the solution (light is detrimental to the growth of roots) and some arrangement for renewing and aerating the solution. It is quite easy to adapt some of the large-scale methods which were described earlier so as to make them suitable for indoor plants. Full details can be found in the valuable book *Soilless Growth of Plants*, by Carleton Ellis and Miller W. Swaney, which is very clearly and simply written. For the benefit of any who would like to try their hand at it, here are two formulae for standard nutrient solutions, recommended by the New Jersey Agricultural Experiment Station.

Standard culture solution

Monopotassium phosphate ..	KH_2PO_4	5·9 g.
Calcium nitrate	$Ca(NO_3)_2$, $4H_2O$	20·1 g.
Magnesium sulphate	$MgSO_4$, $7H_2O$	10·7 g.
Ammonium sulphate	$(NH_4)_2SO_4$	1·8 g.
Water		5 gal.

Trace element solution

Solution A:		
Boric acid	H_3BO_3	3·2 g.
Manganese sulphate	$MnSO_4$, $7H_2O$	3·2 g.
Zinc sulphate	$ZnSO_4$, $7H_2O$	3·2 g.
Copper sulphate	$CuSO_4$, $5H_2O$	0·4 g.
Water		½ gal.
Solution B:		
Ferric chloride	$FeCl_3$	0·8 g.
Water		1 pint

For use add 10 c.c. of solution A and 20 c.c. of solution B to 5 gal. of the standard culture solution.

Notes of the Month

INTRAVENOUS FEEDING

THERE are many conditions in which it is difficult or impossible to feed a patient by mouth. For example, he may be vomiting continually or be too ill to eat. Such conditions are extremely serious and a patient may die within a day or two unless treated. The most important need is for water and salt—sodium chloride. This "saline" is best given by injection directly into the veins and a tremendous improvement is quickly seen in the patient's condition; sunken eyes and dry wrinkled skin are rapidly restored to normal.

If intravenous injection is to be continued for some time, it becomes important to supply some foodstuff which the body can utilize for energy production, and for this purpose glucose is added. The question then arises of the possibility of supplying other essential foods. For example, the proteins of the body tissues are continuously undergoing "wear and tear" and there is no store of proteins in the body. Unless these are replaced, the individual is bound to waste, however much glucose or similar substance is given. Recently, in America, the first attempt was made to supply this need by injection. The protein itself was not injected, but the amino-acids resulting from protein digestion. This avoids the necessity of the protein having to be digested by the patient, for proteins taken into the body have always to be broken down to these amino-acid "bricks" before they can be used for building tissue proteins.

Experiments on dogs were first carried out and showed that such a protein digest was not toxic and, moreover, was able to be used by the dogs for building up their tissues. Then it was tried on patients and was immediately successful. Many, who had shown only slight improvement in their condition when given glucose saline, were greatly improved when the amino-acid mixture was added. There is no danger in its use, moreover, for several patients received injections of this type over a period of weeks with no untoward effects.

The authors of this treatment point out that it should be possible to supply other dietary essentials, notably vitamins, in this way. Thus, by intravenous feeding, a patient might be provided indefinitely with a completely balanced diet and, so nourished, would be more effectively capable of combating his illness.

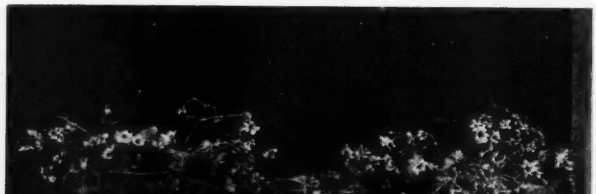
J. Y.

(*Elman and Weiner, St Louis, U.S.A.*)

ARTIFICIAL SUN FOR WINTER PLANTS

THE use of neon lighting for accelerating plant growth during the winter and early spring has only recently come into favour in England, although the first experiments were carried out some years ago in Holland by Dr J. W. M. Roodenburg of the Agricultural College at Wageningen, and at Amsterdam University.

The earliest experiments showed that the flower buds of such plants as *Cineraria* and *Primula malacoides* opened more rapidly when subjected to neon light. It was found that the most successful lighting was a low-tension neon light, as opposed to the high-tension glare of advertising signs and aerodrome beacons. The neon light so

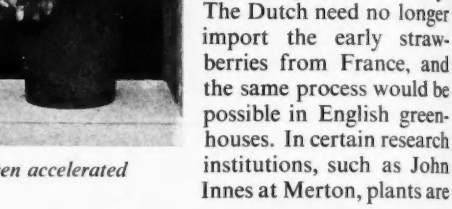


Strawberry plants whose growth has been accelerated by neon lighting

produced was, as one might expect, particularly rich in light rays concentrated at the red end of the spectrum, and it is this particular region of the spectrum which is most useful in supplying the requisite energy for the carbon assimilation of the plant. The effect of the neon light presumably depended on an acceleration of the photosynthetic activities of the plant.

By experiment it was found that this light accelerated the growth, and speeded the reaching of the flowering and fruiting stages, of a wide range of plants including roses, strawberries, melons, lilies of the valley, primroses, begonias and sugar-beet. With seedlings such quick growth gave the added advantage of more rapid growth from the seedling stage, when the plant is most susceptible to the attack of the "damping off" fungus, *Pythium*.

The most spectacular commercial application of neon light to date is in Holland, where strawberries are grown under neon light and yield berries for marketing in February. The Dutch need no longer import the early strawberries from France, and the same process would be possible in English greenhouses. In certain research institutions, such as John Innes at Merton, plants are given an early start in their growth by irradiation with neon lighting. W. E. D.



Strawberry plants grown without neon lighting

(*Science News Service*)

THE MECHANISM OF CORROSION

IF a piece of iron is left exposed to dry air at room temperature, it will remain bright and apparently unchanged for an almost indefinite period. But if the same metal is immersed in tap water or neutral salt solutions containing dissolved air, it will show visible signs of corrosion in a few hours. Recent work has shown, however, that when iron is exposed to dry air, oxidation does occur and the surface layers are converted into oxide: the oxide layer thus formed prevents further access of oxygen to the metal, and thereby protects it from further attack. For this reason the rate of

oxidation at room temperature soon falls to a small value, and although Vernon has shown that the metal is increasing in weight after some weeks, the oxide is still invisible. At higher temperatures diffusion through the oxide is more rapid, and it may grow to such a thickness that it shows interference colours or forms a visible scale.

The thinner, invisible films formed at room temperature can be detected in several ways. Under suitable circumstances it is possible to dissolve away the underlying metal, leaving the oxide film unattacked. When detached from the metal the film is visible to the naked eye. Such films can also be investigated by electron diffraction, and by refined optical methods using polarized light. Finally, the film can in some cases be reduced to the metal by an electrolytic method, and the amount of oxide present can be estimated from the quantity of electricity required to effect this reduction.

Corrosion in water differs from direct oxidation by air because the products of corrosion (rust) do *not* as a rule protect the metal from further attack. In consequence it proceeds at a comparatively rapid rate. It has been proved that corrosion often takes place by an electrochemical mechanism, and this explains why the products do not have much protective action. Consider, for example, the case of a piece of iron or zinc sheet half immersed in a solution of sodium chloride (a horizontal plate with drops resting on it behaves in a similar manner). There is a good supply of oxygen to the metal-solution interface near the water line, but not elsewhere. At the places well supplied with oxygen, negative hydroxyl ions are formed, and the solution in the neighbourhood becomes alkaline. At other points, farther from the water line, metallic ions go into solution. At some *intermediate* position, the hydroxyl ions meet the metallic ions, and the insoluble corrosion product (metallic hydroxide or hydrated oxide) is precipitated. A precipitate of this kind is not likely to protect the metal from further attack.

At the points where hydroxyl ions are formed, electrons leave the metal, and where the positive metallic ions go into solution, an excess of electrons remains behind.

J. N. A.

(*Evans and collaborators, Cambridge. Bengough, Vernon and collaborators, Teddington*)

CHEMISTRY AND CANCER

A GREAT deal of work has been done in recent years on the chemistry of cancer tissues in an attempt to discover whether any differences exist between these and normal tissues, and so perhaps to gain some insight into the nature of the disease. The results of these extensive investigations revealed that normal and cancer tissue are surprisingly alike in their chemistry. One notable exception was the discovery some years ago by Professor Warburg of Berlin that cancer tissue has the property of being able to carry out its vital functions in the absence of air, which is essential for the majority, though not all, of the normal tissues of the body.

Two Dutch chemists, Professor Kögl and Dr Erxleben of Utrecht, have recently reported a very interesting new discovery in the chemistry of cancer. It is well known that the amino-acid "bricks" from which the tissue proteins are built up are "optically active"; that is, each amino-acid exists in two forms which, though containing the same atoms arranged in similar groupings, has these groupings differently arranged around one of the carbon atoms in the molecule. Two molecules differing in this way are called "optical isomers" and bear the same relation to each other as the left hand does to the right; that is, one is the "mirror image" of the other.

Each amino-acid built up into the proteins of the body is almost always present in only one of the two possible optical isomer forms, although it is possible in the laboratory to produce both forms by synthesis. Moreover, the enzymes present in the body and responsible for the constant building up and breaking down of the tissues, can usually only act on the naturally occurring isomer and cannot act on the synthetic mirror image form. Now Kögl and Erxleben find that both animal and human cancer tissue, unlike normal tissue, contain quite considerable quantities of the "unnatural" optical isomers of many of the amino-acids. Since the body tissues are continuously being built up and broken down, it means that these processes in the cancer cells must be profoundly disturbed.

Further work on these lines, now being carried out at Utrecht, will, it is hoped, result in a great deal more insight into the abnormal processes of these cancer cells and perhaps provide some clue in the problem of the transformation of normal cells into malignant cells.

J. Y.

(*Kögl and Erxleben, Utrecht*)

TISSUE MOVEMENTS IN THE EMBRYO

PROFESSOR HOLTFRETER, whose name is familiar to embryologists for his investigations into the nature and mode of action of the organizer, has recently carried out some experiments which seem to provide a new approach to the understanding of those movements of germ-layers and tissues—those flattenings, tuckings, foldings and swellings—which make up so much of the material of descriptive embryology, and whose analysis is one of the principal aims of the science of experimental embryology. He has found that isolated portions of the amphibian embryo may perform movements very similar to those which they would have performed had they remained in their normal relation to the rest of the embryo. Thus if the endoderm rudiment is isolated it eventually undergoes a flattening which corresponds to the formation of the archenteric roof. It also appears that histological differentiation is accompanied by the development of a repulsion between the new organ or tissue and the matrix from which it has been differentiated. In the blastula stage the future ectoderm and future endoderm if isolated and then placed together side by side will coalesce, but after gastrulation they begin to repel instead of attract one another, and under certain conditions will, if mixed together, sort themselves out again. It is even possible, by means of careful timing, to get a sheet of ectoderm to envelop a mass of endoderm and then to change its mind and spit it out again. Similar phenomena are found in the later stages of development; the eye-rudiment, for example, is at first indistinguishable from the rest of the brain and is attracted by it, but when it becomes differentiated a repulsion sets in, and the emergence of the optic vesicle may well be an expression of this.

Whether it will one day be possible, as some biologists believe, to give a complete explanation of these movements in terms of surface forces and other physical concepts must still remain a matter for speculation. But it has at any rate been shown that some of the most important and characteristic features of development are able to proceed after the organization of the embryo as a whole has been destroyed. It seems probable that this analysis of the kinematics of development is the most fruitful stimulus that experimental embryology has received since Spemann's discovery of the organizer.

D. A. W.

(*Holtfreter, Munich*)

Another Earwig Problem

Do Earwigs Fly?

By MALCOLM BURR, D.Sc., F.R.Ent.S.

(Dr Burr, who writes vividly on many subjects from the Balkans to Earwigs, puts forward a scientific problem which an observant amateur can help to answer.)

FEW insects have been the subject of so many and such persistent misbeliefs as the Common Earwig, *Forficula auricularia* L. The superstition that earwigs enter the ear and kill by penetrating to the brain is still held widely through Central Europe, where these insects are abundant and familiar. When Mr Hodgkinson, Fellow of Jesus College, Oxford, found his camp alive with the creatures, his sergeant reported that it was not safe for the men to sleep.

Another misbelief launched by Newman, who was a better entomologist than philologist, and widely held among those of the *intelligentsia* who are aware that earwigs have wings, is that their name is corrupted from a hypothetical form *earwing*, based on the shape of that organ. Very little thought is necessary to realize that the existence, much less shape, of the wings, is a modern discovery. It became known to a very restricted minority of inquirers in the eighteenth* century, while the name in its original form occurs in Anglo-Saxon literature in A.D. 1000, and must certainly have been given by our very remote ancestors.

It is rather surprising that in scientific circles it is supposed that the Common Earwig has almost lost the power of flight, for its possession of ample wings is at least suggestive of the faculty of using them. The wings are, in fact, the most highly evolved in the insect world, and call for a short description.

It is easier to follow their complex structure in the open wing. It will be noticed in Fig. 1 that across it runs a series of veins radiating fanwise from a point in the middle of the fore border. This portion, really the anal area of the primitive wing, is of extremely delicate membrane. Along the fore border there runs a hardened scale with a hinge in the middle. Behind the scale there is a basal area with a few veins of irregular pattern. In closing, the wing

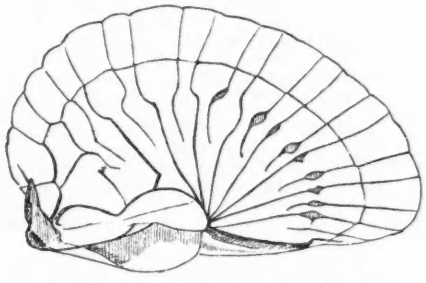


Fig. 1. Wing of the Common Earwig.

shuts up like a fan, along the radiating veins. It is then folded at right angles, across the hinge, producing as a result a little pad, with the hard scale on top. The two pads are then pressed down flat on the thorax, and the elytra, tegmina or forewings, which are small, nearly rectangular, veinless, leathery flaps, come down on top, completely covering the delicate pad except for the hard scale, the tips of which protrude. Inside each of the tegmina, near the inner margin, is a row of minute hooks

* Moffet, in his *Theatrum Insectorum* (1634), describes the so-called wing in his chapter "De Forficulis", but the original drawing attached to his MS. in the British Museum shows that it is that of a Staphylinid beetle

(Fig. 3). These engage in a corresponding row of minute hooks in the middle of the metanotum (Fig. 2), almost like a zip fastener, and the tegmina are thus locked. In this manner the extremely delicate membranes are protected in a way very necessary to insects living in narrow crevices and obtaining their impressions of the outside world almost entirely by touch. This type of wing and its venation runs through the order with but trifling differences, as may be seen from Fig. 6, which shows the wings of a species at the other end of the order.

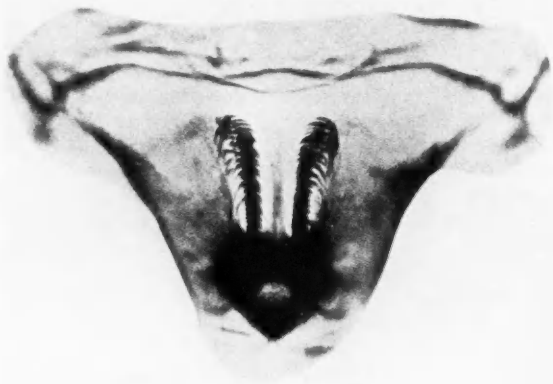


Fig. 2. Metanotum of Earwig, showing double row of hooks.

The outstanding points about the apparatus are its complexity and the strength of the pull of the hinge. Both can be appreciated by anyone who tries to tease open and set an earwig's wing without tearing it. It is this complexity and the elasticity of the hinge, taken with the admitted fact that few people have actually seen an earwig in flight, that have led to the suggestion that the wings are over-evolved and are falling into disuse.

In an elaborate paper on the structure of the earwig wing, Verhoeff (*Arch. Naturg.* 1917, p. 19) states that the earwig wing can be unfolded only under quite exceptional conditions, that is, a specially strong muscular development and a prolonged period of high temperature. He continues that earwigs living in temperate latitudes so seldom meet the preferred conditions of heat combined with moisture that they have adopted a predominantly nocturnal manner of life; that the machine has become over-elaborated and its function hampered by its very complexity. In this sense he regards the wings of earwigs, which, in his opinion, are no longer used in spite of their amplitude, as examples of hypertely. He maintains that the wing can be opened out only when great muscular energy is developed through great excitement, and adds that he has never succeeded in observing it. He comes to the conclusion that the Common European Earwig never succeeds in being worked up to such a pitch of excitement as to develop the energy to overcome the resistance of the elasticity of the hinge.

Confronted with the fact that even in Europe the Lesser Earwig, *Labia minor* L.,

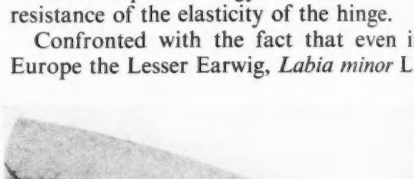


Fig. 3. Underside of tegmen of Earwig.

flies freely in the sunlight, he suggests that it has retained its power because the wing is relatively much bigger and the pull of the elastic joint, *presumably*, less. He proceeds to argue that if such a familiar insect ever did fly, there would be no lack of observations in a region so rich in entomologists

as Central Europe. He has often tried to compel them to fly, but without success. He claims that it is inconceivable that an insect so common in houses should never be seen to fly down from a ceiling or to light. Finally, he claims that the majority of authors agree with him, and that the few confirmatory records are based on isolated instances of untrustworthy observation, or of some abnormal individual, perhaps with bigger wings. In further support he contends that the Shore Earwig, *Labidura riparia* Pall., is so often brachypterous that clearly this species too has lost the power of flight; in fact, he simply assumes that this species cannot fly, stating that the wings are too feeble to lift so big an insect, although they might come in useful as parachutes.

Verhoeff's views are supported by Mr H. R. A. Mallock, F.R.S., who stated at a meeting of the Zoological Society of London (*Proc. Zool. Soc.* 1919, p. 116) that "in the case of earwigs, at any rate the species found in England, it seems more than doubtful whether the wings are ever used. The thorax only contains traces of flight muscles, and I have not been able to distinguish any folding muscles in the wings themselves".

A further supporter of this belief is M. Chopard, Sous-Directeur of the Natural History Museum of Paris. In his recent fine work, *La Biologie des Orthoptères*, reviewed in *Discovery* last January, this distinguished orthopterist alludes to Verhoeff's views, and expresses himself sceptical about the power of flight of the Common Earwig. He claims that the bulk of the evidence is only inferential and that individual records are of exceptional instances, and he, too, regards the wing as an interesting instance of over-evolution.

This formidable array of opinion can be rebutted by facts, but before listing these, let us consider some of the weaknesses of the arguments of Verhoeff.

It is not true that earwigs are nocturnal only in temperate latitudes, and can we believe that our nights are not only moister but warmer than our days?

In suggesting that the Lesser Earwig has less pull on the wings because it is a smaller insect, he is begging the question, and only guessing that the pull is not only actually but proportionately less. He bases his objection on the great strength of the pull of the hinge of the wing, but explains away the instances of recorded flight by the greater size of the wing. This is another guess. Besides, if the wings were bigger, surely the pull on the hinge would be proportionately stronger.

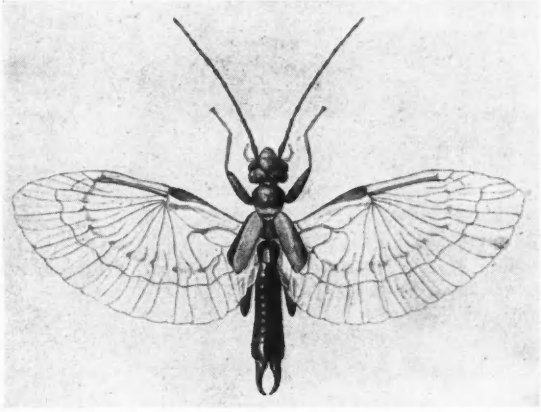


Fig. 4. Diplatys Green *Burr, male, from Ceylon (original drawing by E. E. Green; published in* Trans. Ent. Soc. 1898).

In the case of the Shore Earwig, it is not the possibility of them opening their wings that he questions, but the lifting power of the wings when open. He also claims the prevalence of brachypterism in the order as evidence of the loss of flight. But no brachypterism in the Common Earwig has ever been recorded in this country, since I am now satisfied that the two apparently wingless females recorded by me in 1903 were merely mutilated specimens. Then only brachypterous forms of the Common

Earwig is a geographical race restricted to Italy.

Thus we see that Verhoeff's objections are all purely theoretical and largely illogical. Those of Mallock and Chopard are also theoretical. In order to settle the question finally, Sir Edward Poulton appealed for records of observations.

He himself found the remains of numerous earwigs under an arch where an Eared Bat had the habit of feeding. On the assumption that the bat catches its prey on the wing, this implies that all those earwigs were caught flying, at night.

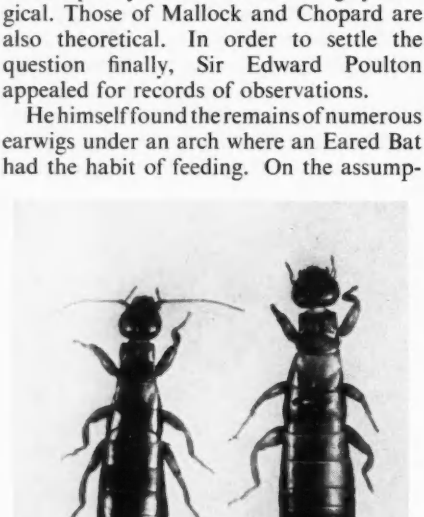


Fig. 5. *A pair of wingless Earwigs*, Titanolabis colossea *Dorn.* (*life size*) *from New South Wales. There is no trace of tegmen, wings or hooks.*

Sir Edward also records that in 1875–6 earwigs invaded his setting-boards in tents, and that "the numbers that appeared suddenly in the limited space could be explained only by flight from a far wider area".

Miss Longfield found Common Earwigs swarming in camps, and states "that they must arrive on the wing and after dark, or we should see them".

Mr Hodgkinson, quoted above, reported that they came swarming into his camp, where "none had been before".

The enormous quantities found in the crops and pellets of the Little Owl are also suggestive of flight.

Now for more direct evidence. Mr E. Ernest Green, former President of the Royal Entomological Society, has often found them dead on the surface of water *with their wings expanded.*

This recalls the oldest evidence, that of Westwood, in his *Modern Classification of Insects*, I, 403, published in 1839. That fine old entomologist found it necessary, a hundred years ago, to put forward proof of their flying. He put the matter beyond doubt by stating that "on some palings freshly coated with pitch only about 18 inches square there were captured no less than 50 or more of these insects, some of which *still had their wings expanded*". There are too plenty of records of earwigs seen actually on the wing. The late J. H. Durrant recorded that he had seen and caught an earwig flying round a lamp (*Proc. Ent. Soc.* 1919, p. xvi). Miss Longfield states that she has certainly "seen it alight and fold its wings in daytime".

Sir Edward Poulton quotes an old notebook of J. C. Dale, found in the Hope Department at Oxford: "Sept. 4, 1843.... Took *Forficula auricularia* flying by moonlight."

In the United States, where the Common Earwig is an immigrant settler, Fulton states that he saw one close its wings by its own elasticity. There is also evidence from Germany. In Hanover, Herr A. Fritze saw an earwig in broad daylight fly on to a bed of Phlox. There was no mistake about it, as he caught and verified the specimen. In his note he states that at the time it never entered his head that there was anything unusual in this and so he did not record the incident for a year or two (*Ent. Rund.* XXXIII, 39, 1916). That reasoning probably accounts for the general silence upon the subject.

On a warm September afternoon in 1919,

at Walding, Herr Richter noticed, to his surprise, some Common Earwigs flying about. He watched one running on his sleeve, when it suddenly opened its wings and took off. In a quarter of an hour he counted no less than fourteen, all flying in the sunshine. Later in the season, on a cold October night, he saw two earwigs fly to the lantern in the Landestheater in Linz.

A similar instance is noted in this country by W. E. Collinge (*J. Econ. Biol.* III, pt. 2, 1908), who mentions earwigs flying in at an open window between 9.30 and 10.30 on three warm, dark, sultry, calm nights in succession. Twenty-six entered, all males. He also gave instances of flight in the daytime.

The late Professor F. V. Theobald states that later in the year earwigs used to come flying to the light in his house, and in August 1867, D. W. Douglas caught one flying at night in a garden at Lee.

Although I have studied earwigs for many years, and it is over forty since I first described a new species, I have never been lucky enough to see a Common Earwig on the wing, mainly because I have never specially looked for them, as I never questioned their power. Last January, however, an insect was seen by my wife to fly across the drawing-room and land on the sofa, and on inspection it was found to be an earwig.

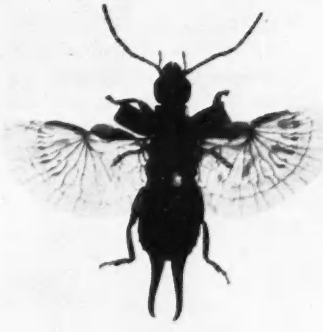


Fig. 6. Female of Common Earwig with wings expanded.

It is probable that earwigs are seen flying far more often than is recorded, as not many entomologists question their power. That was the case with Herr Fritze, and also with Mr Bernard Embry, who noted in the *Entomologist's Record* (1939, p. 9), that many years ago he had seen an earwig alight in front of him with its wings extended. They were "folded with great rapidity and the elytra closed over them". Mr Embry never thought of recording this until I asked him to do so.

In the same way, Mr N. D. Riley, Keeper of Entomology in the British Museum, told me that he has never recorded a similar instance that he noticed many years ago. He wrote to me that he saw one alight on some flowers on a fairly bright day. He wrote that "something flew past me and alighted on a flower, simultaneously folding and tucking away its wings. The action was so quick that the wings were out of sight almost before I had realized that the insect was there".

Mr R. E. Freeman, of Hope Department, Oxford, informs me that he has twice seen earwigs fly.

This evidence proves conclusively then that earwigs fly, and it seems that it is their preference for dark nights and the rapidity with which they close the wings that has caused any doubt on the subject.

The Psychology of Press Competitions

By Stanley Brogden

(In our November 1938 number, Mr Brogden wrote about the revival of superstition in England to-day, and in particular deprecated the popularity of Astrology and its influence. Below, he discusses the "racket" of Press Competitions, which, he says, are the second greatest example of mass hypocrisy in Britain.)

A few months ago a not unknown social worker in the north of England told me quite seriously that the football pools had stood between England and revolution for ten years.

To another person, this statement would have seemed either idiotic or amazing. To me it was simply an overstatement, although a very good argument can be made for this line of thought.

The football pools are probably the most amazing development seen among the working and unemployed classes in the history of this country. Yet, although great attention has been attracted to the pernicious aspect of this gambling, both by religious bodies and by the more staid organs of the press which do not boast advertising revenue from that source, the social student seldom bothers to investigate another phase of the modern gambling craze. This second aspect of the desire for quick riches is almost as great as the pool system and operates throughout the year. It is the newspaper competition.

Four years ago I was called in to assist in the judging of a newspaper competition organized by a famous soap manufacturer's advertising agent. It was my introduction to the inside of a social phase which had long formed a study of mine. The organizers had advertised prizes totalling £2000, and the object of the uproar, which occupied full pages in the national and provincial dailies, was to secure a name for the mythical infant whose inked form appeared as a cartoon in the firm's advertising copy. We received some quarter-of-a-million entries. I was immediately struck by the fact that 95% of the entries came from working-class wives, charwomen and children. The odd 5% included a Russian Princess, ex-colonels, an admiral, and many other retired people of the moneyed classes. The great middle class was almost unrepresented. The second most striking thing about the entries was that, despite the boast of universal education made by this country, easily 30% of the coupons were almost illegible, and betrayed the most astounding illiteracy. This illiteracy became worse when we were later asked to judge a letter-writing competition. Nearly 50% of the entries could be rejected on sight, being without the semblance of coherence and often pitifully absurd. 10% of the entries passing through my hands had been written on any paper which was to hand—brown parcelling paper, half a paper bag, the back of bills or receipts, old envelopes, and even, in six cases, upon a sheet torn from a toilet roll. The latter entries were not intended to be indecent: they were honest efforts. The three grossly obscene entries arrived on notepaper of excellent quality, being, of course, anonymous.

Of the entries in both competitions 80% followed one of three identical lines of thought, thousands being almost word for word the same. Only one entry in a thousand betrayed the semblance of originality.

It might be thought that these competitions, being free of entry fee, were abnormal. This is not so. The most popular form of commercial competitions, as run

by the Sunday newspapers, is the "Bullet" idea or some variant of it. In these the average entry fee is a three-halfpenny stamp, and most competitors enter at least two coupons. Of these competitors 90% are working-class people or from the ranks of the unemployed. This can be proved by the fact that there has been hardly a handful of these competitions in which a professional or moneyed man has won a prize of importance.

Indeed, it would be difficult for an educated man to do well in the Bullet type of competition. Just what constitutes a good Bullet has never been defined. The judging of Bullets is left entirely to the sense of humour of the judge concerned. After seeing the winning Bullets in hundreds of these contests I am still at a loss to say what makes a Bullet good. Take the following examples (the Bullet is, of course, the four-word tail to be added to a phrase example):

A recent £1000 prize was tucked away in the pocket of the gentleman who sent in:

"Sonnie's World....Where's Dad's Place Secure?"

Other fortunes went to the people who wrote:

"Mother and Dad....Their 'Match', My Torch."

"Spoilt The Picture....For Mars, 'Light' Entered."

These are average examples. Can any person adequately explain the light of genius which shines from these Golden Bullets and which ranks them head and shoulders above a million other entries? It is impossible. The complete incoherence of the average prize-winning effort in Bullet competitions is staggering. The only method of judging these entries is to pick upon some coupon which is inscribed with something that approaches brevity of wit.

Some of the greatest riches to be gained from the newspapers to-day are given to those persons who solve crosswords. That these crossword competitions are permitted to exist shows the idiocy of the officials who pronounce the law. If there was ever a pure chance gamble, the crossword puzzle of the Sunday newspapers is that *in extremis*. The alternatives afforded the long-suffering entrant in these puzzles are so complicated that the average odds are ten million to one against winning. The rules state that the judges' solution is final, and that the judges make their solution according to the most sensible answer which can be taken as the reply to such questions as

"One is expected to have a -atch."

What? A hatch, a batch, a catch, a match, a latch, a watch? Several possible replies to one question—some more probable than others. Can any man say that the answer should be match or watch? It is impossible to deny that every alternate-answer crossword puzzle competition in this country is simply a gamble and therefore illegal. No amount of skill whatever can find the correct solution to any crossword which permits almost unlimited alternatives.

There is hardly one form of commercialized competition in Britain which does not constitute a flagrant gamble. The "skill" label is pure myth and the newspapers know it. I have planned several competitions myself and I worked to the order: "Get around the law. There are loopholes in it." To all intents and purposes these competitions are as much lotteries as the officially maligned Continental sweepstakes which the British Government will not sanction.

It may seem that the newspapers which run these competitions must do so for circulation boosting results alone, and that money is lost by the publishers who award several thousand pounds as prizes. This is not so. It is said with some knowledge that one combine of magazines has banked a surplus of £2,000,000 from these competitions, every penny of it the profit made on competitions which award £2000 in prizes for an entry fee of three-halfpence. The colossal number of entries may be imagined. And in almost every case that

threepence or sixpence which comes into the offices in the form of three-halfpenny stamps is from a home which can ill afford the loss of a penny. When the religious leaders speak of people who sacrifice the Sunday dinner in the hope of sudden wealth they are not speaking without knowledge.

From the psychological aspect, judging competitions can be very interesting. During the crisis in September, the effect on the public mind was astounding. Entries for one big competition running at that moment in the national press, a free entry contest, fell off by 20 %. During that week the number of defective entries was increased by 3000 %, the number of political solutions to the competition being raised by 500 %. The percentage of illiterate or illegible entries rose to 40 %, and the number of unstamped envelopes was trebled. Several hundred people sent in envelopes without coupons. Nearly a thousand made some mistake in addressing the envelope.

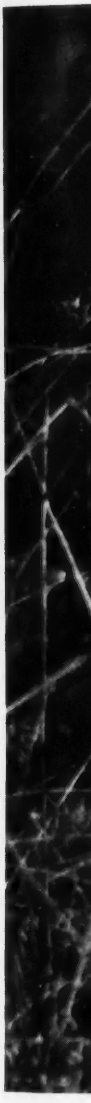
The desperation of many entrants can be judged by the fact that over the last five years the percentage of entries sent in by professional tipsters or solutionists has risen from 1 to nearly 20 %. Thus solutionists are working one of the most prosperous "rackets" in the country. Their entries are so puerile that most judges merely flick them over. They often arrive in sheets. One man paid a solutionist £10 and sent in several thousand entries, only one of which was even capable and won a small prize. Solutionists work from basic ideas. They allot each competition to the expert (*sic*) who has studied the type of competition in question and he jots down a series of ideas which come to him in Bullets. From these thousands of variants are made, and that is what damns the solutionists' entries. In crosswords they work out thousands of alternatives on a mathematical basis and trust to luck that one will win. For this benign service the client pays from a penny to threepence a line or solution, as the case may be. That this industry is not being hit by world conditions is proved by the fact that one solution factory in West London employs twenty solutionists and fifty clerks and posts fifty thousand letters a week. They turn over some £50,000 of business annually. A friend of mine recently advertised in a popular weekly. His one-inch advertisement brought him fifty clients within three days of issue, forty of them enclosing postal orders ranging in value from sixpence to a pound—a very fine example of the trust which we British people place in the truth of advertising.

The whole aspect of the competition racket—for it can be called by no other adequate name—is one which must revolt any intelligent man. In its basic appeal to the poor and the ill-educated, it is the second greatest single piece of mass hypocrisy in modern Britain.

Letters from Readers

Australian Marsh Bittern

I THOUGHT some of your readers might be interested in these photographs. This comparatively rare and extremely shy bird is an inhabitant of marsh and swamp land, in which it is seldom seen, but not infrequently heard. Its eerie, booming cry, and its general invisibility, is largely responsible for the legend of the Bunyip, which looms large in Australian myth as a sort of local Loch Ness Monster, a horrendous —and invisible!—creature inhabitating remote swamps.



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Marsh Bittern disturbed

The photograph above shows a bittern adopting its first protective attitude when disturbed; rigidly motionless, with outstretched neck and beak, under which conditions it blends admirably with the reeds and grasses of its natural habitat.

Ruffling its feathers, it takes up this intimidating pose

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If cornered, the bird, though perfectly harmless, ruffles its feathers and takes up the intimidating pose shown in the second picture.

S. A. PEARL, Melbourne.

Ruffling its feathers, it takes up this intimidating pose

Clouds

I READ with very great interest your article in the May issue about clouds and their meaning. Until I read that article, a cloud was to me just a cloud, but now I find myself walking about with my eyes continually on the sky, trying to identify the various types of clouds seen in different places at different times of the day. The other day I caught sight of a most extraordinary cloud formation, which seemed to me so like the head of a woman that I photographed it, wondering to what class such a cloud might be assigned!

L. J. LUSCOMBE, Cambridge.

The Longevity of Oarsmen

THE Note in the July number of *Discovery* on "The Longevity of Oarsmen" is interesting, but I cannot help doubting whether the investigation mentioned is a strictly scientific test of the effect of rowing on health. The article says that the mortality of oarsmen who took part in the Boat Race between 1829 and 1928 was compared with that of ordinary insured people. But surely the difference between these two groups is not confined to the fact that one group rowed while the other did not. Occupation and financial circumstances (both of them important factors in determining longevity) are only two of the other ways in which these groups may differ. In my opinion, a better way to ascertain the effect of rowing on health would be to compare the mortality figures of past rowing blues with those of past members of the universities during the same period.

ERIC W. J. SINCLAIR, Edinburgh.

(*We passed on this letter to the author of the Note, whose reply is given here.*)

THE choosing of appropriate "controls" in an investigation of this sort is a very difficult problem. Sir Percival Hartley and Mr Llewellyn in their original article stated, "We have been obliged to compare the oarsmen with a body of men living at the same time, insured and accepted, indeed, for life insurance at ordinary rates and free from any serious blemish, but probably not possessing those advantages of physical fitness and social and economic standing enjoyed by the athletes concerned. The ideal would be to compare the life-expectancy of the oarsmen with that of their fellow graduates, living at the same period and under similar conditions except that they did not participate in such strenuous exercise."

Such a comparison has been attempted by an American investigator, Dr L. I. Dublin, who studied the life histories of some 40,000 students. His results showed that the athletes had a mortality figure almost exactly equal to that of the ordinary graduates. Most interesting, though, was the fact that men gaining honours in their examinations had a lower mortality than either the athletes or the ordinary graduates. Commenting on these results, Hartley and Llewellyn write, "We must not forget the difference in temperament between the athlete and the scholar—the former leading an active life and possessing an ardent spirit, which...may drive him into enterprises and risks, not free from danger to life, which the scholar is more likely to escape."

It is clear that more work will have to be done along these lines in order to obtain a very exact idea of the effect of rowing and

other athletic pursuits on health and longevity. But Hartley and Llewellyn's figures certainly warrant their conclusion that their research "gives no support to the idea that strenuous rowing in healthy subjects, when combined with adequate training, places any undue strain upon the cardiovascular or other organs and leads to any diminution of longevity."

J. Y., Cambridge.

Gold Cures in Modern Medicine

By William B. Proudfoot

MUCH that does not glitter may nevertheless be gold. Such, anyway, is the case with the clear colourless compounds of pure gold that are now being used in the treatment of certain forms of tuberculosis and rheumatoid arthritis. Medical opinion is coming to regard gold as something of a specific remedy for these two stubborn ailments. Although the matter is still in the experimental stages, there is little doubt that gold therapy, as doctors call this form of treatment, is to be ranked as one of the great achievements of modern medicine.

Gold has been known long enough; and doubtless it has caused more ills than it can ever cure. How then has it come to be used in medicine? What is its action? How do you take it? How does the chemist make it up? These questions, of course, are the business of the doctor and the chemist: but the enquiring layman, too, wants to know something of these epoch-making changes affecting public health.

It was in 1925 that British doctors first began to take an interest in the use of gold for the treatment of tuberculosis. This innovation had already met with some success on the continent. It was Prof. Möllgaard of Copenhagen, who furnished the British Medical Research Council with supplies of "Sanocrysin", a special compound of gold, prepared under his direction by the Dansk Chemo-Therapeutisk Selskof, the company that had been formed to operate the patent. As a matter of fact Prof. Möllgaard started experimental treatment with gold as early as 1914, and most of the interval between then and 1925 had been spent on researches into improving the form and nature of the gold compound, which he had introduced. "Sanocrysin" represented the successful result of these researches.

The precious stuff was distributed among the large hospitals and important tuberculosis centres in Britain, and clinical trials began. Results at first were rather inconstant owing to lack of experience with regard to exact dosage. It was not long, however, before it was realized that the experimenters were on the threshold of a great discovery.

Great advances have been made since then, particularly with regard to selection of suitable patients, in connexion with the exact dosage, and in the production of new forms of gold chemicals. Certain advanced cases of tuberculosis are not benefited by the treatment. Tuberculous subjects seem to show a reaction to gold treatment, rash and rise of temperature, the severity of which is roughly proportional to the intensity of the tuberculosis. Best results are obtained in the early stages of certain types of pulmonary tuberculosis.

The great difficulty that has confronted all these researches is that gold is not only a poison capable of producing symptoms of metallic poisoning, but it may also have an aggravating effect on certain kinds of tuberculous conditions. All sorts of obstacles had to be dealt with. It was found

that patients should not be exposed to bright sunlight after gold treatment on account of the lilac pigmentation of the skin that occurred. Most of the undesirable effects are mitigated by the administration of compounds of calcium and glucose along with the gold.

Although medicine owes "Sanocrysin" and the general technique of gold therapy to Prof. Möllgaard, it is really to Robert Koch of Göttingen that we are indebted for the original idea, the idea of finding a substance that would prove fatal to the tuberculosis germ. Robert Koch is the outstanding figure in the history of tuberculosis. He it was who discovered the bacillus or germ of tuberculosis—one of the greatest discoveries of modern medical science. Koch actually showed that certain metallic salts, especially of gold, had a lethal effect on the tuberculosis organism in concentrations which, however, were injurious to the health of the patient.

Koch's great discovery was made in 1882; but even at that time this idea of finding a chemical with a specific action against a particular disease-producing organism was not altogether new. The pioneer in this branch of medicine—chemotherapy it is called—was the famous Paul Ehrlich, a German bacteriologist. A contemporary of Koch, his most brilliant research was the production of "Salvarsan" or "606", a chemical with a specific action against certain venereal germs. It was called "606" because it was the sixth hundred and sixth compound which he had made and tried out before meeting with success. Those who know intimately the work of great scientists marvel more at their tremendous patience than at their great genius.

* * *

The evolution of the use of gold in tuberculosis was along such lines as Koch and Ehrlich and their collaborators laid down. The gold, however, does not appear to have a direct lethal action on the tuberculosis bacillus, but acts rather by stimulating the tissues of the body to oppose and ultimately defeat the invader.

The medical use of gold is well enough established in connexion with the treatment of tuberculosis: but as a matter of fact the most dramatic results of gold therapy are being obtained in the treatment of rheumatoid arthritis. This ailment does in fact show considerable resemblance to tuberculosis and to certain other illnesses that had been shown to respond to chemical treatment. There is the same general debility, anaemia, and destruction of tissue. It was this similarity that led Jacques Forestier, M.D., of Paris, to try out gold salts in the treatment of rheumatoid arthritis. Forestier obtained very good results in over 70% of his cases, many of which were severe and failing to respond to other forms of treatment.

* * *

Following certain personal observations of the results of gold treatment, two Leeds doctors in July 1934 started the Leeds Public Dispensary, an arthritis clinic at which the treatment was to be entirely by administration of gold. Amazing results were almost immediately obtained. In some cases the cures effected were little short of miraculous. By July 1936 four hundred cases were treated. Hopeless cripples were afforded instant relief, and in many cases, formerly given up, a complete cure was obtained. The statistics of the Leeds Dispensary show that, of these four hundred cases, complete cure was brought about in over 20%, marked improvement in over 50%, and slight but definite alleviation in most of the remainder.

Statistics are dull enough things as a rule, but here they provide a striking testimonial to the value of this new form of treatment. They fully substantiate the claim which medicine modestly makes that, although gold is a toxic drug, if the treatment is carefully carried out, results are superior to those obtained by any other method of treatment.

The gold compounds used in this form of treatment are mostly subject of special patents. The original compound "Sanocrysin", still in use, was discovered by Prof. Möllgaard, and patented in 1925. It is made from pure gold and photographic "Hypo", prepared of course in a highly purified state. The gold is first of all dissolved in bromine water, and the brown crystalline product which is obtained is heated to yield a compound called bromide of gold.

Bromine is one of the elements. It is a dark red liquid resembling chlorine in most of its chemical properties, although not in appearance. Commercial supplies of bromine are obtained from Germany, where considerable quantities of bromine compounds are found, particularly in the Stassfurt salt deposits of Saxony.

The bromide of gold is dissolved in water and mixed with a solution of hypo.

There is an interesting parallel between the formation of the gold-hypo compound and the ordinary photographic use of hypo, in which a silver-hypo compound is involved. The exposed film after development presents a surface coated partly with metallic silver and partly with bromide of silver according to the action of the light. The hypo, with which the film is now fixed, acts by forming a compound with the silver bromide. This compound, called sodium silver thiosulphate, is soluble and is washed away, leaving the deposit of silver to form the negative. Sodium thiosulphate is the correct chemical name for hypo. It is frequently erroneously called sodium hyposulphite.

Whereas the silver-hypo compound is soluble, the gold compound is prepared in an insoluble form, and is actually precipitated by the addition of alcohol. It is produced in pure white glistening crystals. Chemically it is similar to the silver compound, and its correct name is sodium gold thiosulphate. It contains 37% of gold.

For purposes of administration to patients the compound is dissolved in carefully sterilized water and this solution is injected into a vein.

The administration of the drug must be conducted with the utmost medical skill if undesirable effects are to be avoided. The injections are given at weekly intervals for a period of several months. Thereafter the treatment is interrupted for a period or "holiday", lasting about as long as the treatment. The actual amount of gold injected at any one time is small, but over the whole course a patient may have consumed as much as thirty grains of pure gold—about one-tenth of an ounce at 140*s*. per ounce.

"Sanocrysin" is not the only gold compound used in medicine. There are numerous others. Most of them are complex organic chemicals. They belong to classes of chemicals associated with complicated synthetic derivatives of benzene and other coal-tar products rather than with simple mineral chemicals like hypo. It was one of these organic chemicals, called "Lopion" and made in Britain, that was used in the historic experiments at Leeds.

The spectacular success that has attended the introduction of gold into medicine is the more interesting when we realize that it is the first time gold has ever been used for medical purposes. Strangely enough, gold was one of the two things in connexion with which the alchemists of old spent most of their days trying out fruitless experiments. For hundreds of years they searched for the "philosopher's stone" by means of which they were to turn the base metals like lead and copper into fortune-making gold. Later, when alchemy took a medical turn, the mostly fraudulent efforts to make gold were replaced by the search for the "elixir of life". The gold cures of modern medicine are certainly proving to be the elixir of life to sufferers from tuberculosis and rheumatoid arthritis.

The Dormouse and the Harvest Mouse

By

PHILLIS KELWAY

"Like many other small mammals in this country the harvest mouse is face to face with a crisis."

"For weeks I endeavoured in vain to persuade the dormice to eat less fruit."

The Dormouse

The Dormouse

THE dormouse is a vegetarian and, more especially, a fruitarian, but in nature books the statement is often made that he lives largely on insects. Perhaps individual dormice enjoy an occasional insect just as certain people have a partiality for snails, but I believe that if a dormouse eats an insect he must be very hard up. Of four dormice now in my possession only one has been known to devour a meal that was not vegetarian, and he departed but once from his normal diet. Night after night I placed shiny yellow wriggling mealworms in a small bowl in the dormouse house, counting them carefully then, and again in the morning when they were removed. No insectivorous bird can resist a mealworm; nor any toad, nor frog; nor even the long-tailed field mouse, who is not officially described as a lover of insect meals. Every morning, after taking the mealworms from the dormouse home I have placed them before the long-tails living in another house, and within half-an-hour a crackling and scrunching has shown that long-tails are not amiss to mealworm for breakfast in spite of a banquet of dandelions, nuts and apple the night before. The dormouse who ate mealworms partook of two; he tasted them, pulled portions of the soft body from the outer scaly skin and discarded the remains neatly jointed.

For weeks I endeavoured in vain to persuade the dormice to eat less fruit. As

"*The Dormouse is a vegetarian*"

caterpillars are supposed to be great favourites, I collected every variety growing on hedges that I could find—hairy and bald, fat and thin—but the dormice thrived on their buds, blackberries and nuts while the caterpillars waxed fat on their own particu-

lar foliage. The dormouse house became a breeding cage for caterpillars, and never before have I reared successfully such vast numbers. Sometimes I cut down the vegetable diet to the barest necessity, but the dormice were not to be coerced, and eggs of many moths hatched in the dormouse house.

Of fruits, dormice seem to prefer banana, grape and pear, but they will eat a sweet apple after they have peeled it with their broad capable hands. They like the seeds hidden in the scarlet flagons of the hips of the dog rose, and they store away cob and hazel nuts in dozens during October before they retire for their winter sleep. Two of my dormice have carried a whole pound of filberts into a hollow tree trunk in one autumn night, but in spring and summer the instinct for storing seems to leave them. Tips of shoots of many shrubs are greatly enjoyed. On one occasion a beech stripling, planted for the comfort of the dormice in their shrubbery, was denuded in a couple of nights of its fresh green leaves. The buds of brambles are eaten when nothing else offers, and most dormice are extremely fond of the green calyces which enfold the yellow flowers and buds of brooms, but the actual flowers are thrown to the ground with a pretty gesture when the green part has been nipped off. To gardeners this may appear as though another pest must be added to their already lengthy list, but unluckily dormice are rare in comparison with our field mouse and field vole, and only a few gardens are fortunate enough to provide them with hospitality.

"The Harvest Mouse has many foes"

The Harvest Mouse

Like many other small mammals in this country the harvest mouse is face to face with a crisis. He has many foes: hawks, magpies, probably little owls, crows, rooks and a few other birds, besides stoats, weasels, foxes, cats, dogs and similar animals; but in spite of a long list of natural enemies, one animal only can be termed a dangerous aggressor. Man alone deserves that title. Modern machinery has either directly slain or indirectly caused the death of innumerable harvest mice in the southern counties.

From observations this year I would say that *Micromys minutus* is a rapid breeder.

The Harvest Mouse looking for seeds

Two females in captivity have produced two families apiece; in the wild, three families to a female may not be an abnormal rate of increase, and it is probable that early-born young reproduce themselves late in the year of their birth. In the first week of May this year one female had four young, but unfortunately they were all males. Next year I shall hope to have a family or two of mixed sexes in the spring, which should make conditions easy for another generation in the summer.

A wet summer followed by a wet winter is a severe tax on the *Micromys* population, for they are not by preference subterranean dwellers, seeming incapable of digging holes for themselves, although they fashion innumerable runways measuring about half an inch in diameter through the grasses. Nevertheless, I have found many cosy nests in the osier beds of Somerset, these being constructed of coarse grasses outside and lined inside with the white pith of reeds. Such nests are rarely built more than 6 in. above ground level, and many are on the ground itself in the centre of tufts of rush or grass.

The food of the harvest mouse consists mainly of seeds and succulent shoots. Although he does not shovel grass into his mouth with the same abandon as the field vole, he is very fond of juicy stems. He climbs the stalks of grasses and of many

The prehensile tail of the Harvest Mouse

Dormouse

Harvest Mo

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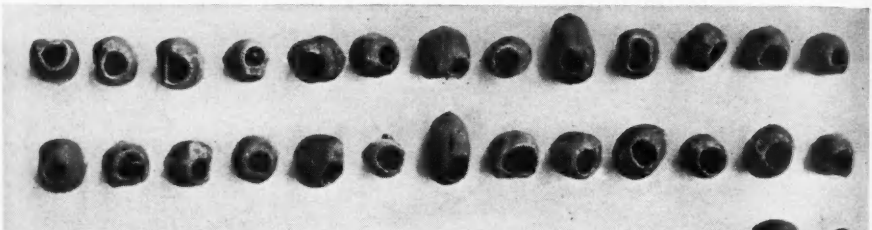
Dormouse

Harvest Mouse

wild flowers in search of seeds; and is of course very much at home in a field of wheat or oats, but he seems to prefer both of these in a milky state. He feeds upon hard corn in winter, but he chews a green ear of wheat in August with a rapt ex-

pression on his face which does not appear when he is nibbling grain.

The prehensile tail of the harvest mouse is his most interesting feature. In one photograph it can be seen used as a balancing pole, while in another it is curling at the tip like a pea-tendril searching for support. I have held a 14-day-old baby mouse in my hand and watched his 30 mm. tail waving vainly in a strong-minded endeavour to twist itself around my finger. At 16 days he could loop the tip successfully around a stalk of wheat.



The two top rows of the nutshells were opened by dormice and the two lower rows by long-tailed field mice

The Bureau of Human Heredity

THE Clearing-House method initiated a considerable time ago largely in commercial concerns, has of recent years become increasingly familiar. Collection of data arranged for easy accessibility is an absolute necessity for those who must regulate their activities according to facts. World intercommunication is one factor which renders the method necessary; any activity dependent on scientific data has also to cope with rapid increase in knowledge. This is not merely a question of added data, for frequently a new discovery entails some revision of earlier conclusions.

In 1930, an International group was formed of research workers in Heredity of Man. Within two years this small body decided that the time was ripe for setting up a Clearing House for human genetics. After some deliberation, the task was entrusted to the British Committee affiliated to the international group. Another two and a half years elapsed before the work actually began. Under the title "Bureau of Human Heredity", this Clearing House is now running (in collaboration with the Galton Laboratory, University College) in offices at 115 Gower Street, London, W.C.1.

The undertaking would be extremely expensive were it necessary to purchase the publications required. That method would not be as satisfactory as free interchange, for it would limit data to published material. Actually, valuable observations on human families are made by busy practitioners as notes which run the risk of loss unless manuscript data can be carefully filed.

The object aimed at by the Council of the Bureau is highly practical; in addition to a collection as complete as may be of ascertained genetical facts, it is intended to give information by collation of the material collected to those who need it. The method adopted has met with encouraging success. In the first instance, the American Medical Association sent its list of medical journals which has been found to be practically complete for all countries. A notice was sent to Editors for publication, inviting all who had data to contribute these freely to the Clearing House. A further source of material comes through bibliographical search and interchange with those genetical journals which publish periodical lists of literature. Bibliographies form a list of authors and subjects which goes considerably beyond the material actually collected in the Clearing House. From that list, personal requests are sent to research workers asking for reprints as free contributions. A *quid pro quo* of some value to workers is given by furnishing them with references which they require on special points (complete bibliographical lists are not sent as that service is available elsewhere and entails considerable expense).

A problem which greatly concerned those who first organized the work lay in the validity of results. It is interesting that what seemed the most insoluble difficulty in the Clearing-House system is almost self-regulating. By bringing all work on one particular trait together, discrepancies readily appear. Where correspondence with the authors does not settle the question, it is referred to an international group of those with the most complete knowledge of the issues involved. In point of fact, this procedure is very rarely necessary. Another aspect may be worth mention, that is, the importance of neutrality. This is perhaps the salient difference between the Bureau for Human Genetics and Clearing Houses for data of other types. Wherever man is concerned, opinions and views come into play. A fact-finding organization must by some means avoid bias. The Bureau has no objective beyond complete collection of data and the strictest possible accuracy. In result, this attitude has brought co-operation from workers of the most diverse creeds and ideologies. The correspondents' index runs into hundreds, in every part of the world, where scientific research is pursued. It has been most cheering to get such generous voluntary co-operation everywhere for, as mentioned above, it achieves the Clearing-House aim far better than any other system.

It may interest readers to know something of the volume of material collected. This part of the work has only been going seriously for two years, and results in over 900 sections on human differences with a considerable further number on the related points of methodology, statistics and details of diagnosis. Completeness cannot be claimed and is perhaps only academically desirable; for practical needs the most recent findings are required, and here the files are fairly up-to-date.

One hears the question "What is the practical value of this laborious machine?" For the answer, we can best turn to modern husbandry. No careful agriculturalist omits to consider each variety of plant or animal in relation to its environment. Grains or pasture on a new soil are not sown until the type of soil has been ascertained, and from one of the Agricultural Clearing Houses it is learned what variety, amongst the numerous kinds of oats, wheat, or whatever it may be, will flourish on that particular acreage. Strangely enough, we do not yet think of man as having varieties, ignoring the obvious differences which serve now chiefly as subjects for treatment

by Belcher or Low. We expend vastly in energy or money on improvements in human environment without any consideration of which environment will suit the variety with which we deal. And in our highly mixed populations, each individual requires assessing as to his needs. Genetics alone gives the clue as to which human differences are accidental and which discriminate constitutional variety or type. The science is a long way from furnishing all the data needed. Linkage, now well known for many lower organisms, is becoming the major quest amongst human geneticists, and from this work our problem will, stage by stage, be solved. Teachers, doctors, social workers and eventually rulers need this new knowledge, which touches every side of human life.

C. B. S. HODSON

Meteors

By

Rev. M. DAVIDSON, D.Sc., F.R.A.S.

President of the British Astronomical Association

IT was generally believed until comparatively recent years that nearly all meteors (commonly known as "shooting stars") were members of our solar system, moving around the Sun in elliptic orbits in the same way as comets move. It is true that there are well-known meteor showers that are definitely associated with comets. They are, in fact, merely the debris of comets which are disintegrating, the small particles which compose the nucleus dropping behind as the comet rushes around the Sun, though following in the wake. The Earth passes through this debris at certain times, and when the particles encounter our atmosphere, the heat produced by the friction causes them to volatilize very quickly. Thus, on 10–12 August, the Earth encounters the debris of Comet 1862 iii, and the result is the well-known shower, the Perseids, so called because the apparent tracks of the meteors, produced backward, converge to a point close to η Persei, near Right Ascension 3^h and Declination $+57°$. Other well-known showers are the Leonids on 13–14 November, which are associated with Comet 1866 i (Temple); the Andromedids, 18–25 November, which are the debris of Biela's Comet; and the Aquarids, 1–6 May, which are probably associated with Halley's Comet.

Besides these meteor showers known to be connected with comets, there are many other showers which are not associated in any way with comets past or present. In addition, there are very many meteors which do not appear to have a well-defined radiant, that is, when the tracks are traced backwards on a celestial globe, they do not converge to a point or small area. The name "sporadic" was given to these meteors, and though they were placed on a different footing from those with definite radiants, they were generally believed to be members of our solar system, and it was supposed that they were moving around the Sun in orbits similar to those pursued by the comets.

Within recent years our knowledge of this last type of meteors has been considerably enlarged as a result of the Arizona Expedition for the Study of Meteors, organized by Harvard College Observatory. It would occupy too much space to describe in detail the excellent equipment with which the

research was carried out to obtain the most accurate results. It will suffice to say that practically all these sporadic meteors were shown to be moving with velocities considerably higher than they would have if they were members of the solar system. The velocity which a body pursuing an orbit around the Sun possesses in the neighbourhood of the Earth is about 26 miles a second, assuming that the orbit is a very elongated ellipse, as is usually the case. If such a body meets the Earth moving with a velocity of 18½ miles a second, the relative velocity of encounter is about 45 miles a second. If it is overtaking the Earth, the velocity should be less than 8 miles a second, but the attraction of the Earth increases this to 10 miles a second. Now, in the case of some of the sporadic meteors, it was shown that they had velocities relative to the Earth much greater than 45 miles a second; indeed, some of them were moving at a speed, relative to the Sun, of 125 miles a second, nearly five times as fast as they could move if they were controlled by the Sun's gravitational pull. It was obvious that these small bodies had come from the depth of space into our solar system, and their number was shown to be enormous. Taking into consideration those of ninth magnitude and brighter, it was estimated that each day ten thousand million struck our atmosphere. It might seem that the mass of the Earth must be increasing with such continuous accretions, but as the particles are very small, the increase is almost infinitesimal. It has been estimated that the daily addition to our planet is 70,000 g., that is, about 154 lb., from which it will be obvious that these particles are extremely minute.

There are numerous problems arising from the results of the expedition, such as the density, temperature and composition of our atmosphere at various heights, as well as the composition of meteors, the sporadic type being generally iron, according to the spectroscopic evidence, those with defined radiants being usually stone. The great question arises, "Where do these small bodies come from?" Some will probably have a ready answer, "They are expelled by the stars." Unfortunately such a simple solution as this is open to grave objections. We can conjecture on their origin, but the true explanation, which, incidentally, will probably throw some light on many unsolved problems in cosmogony, lies with posterity.

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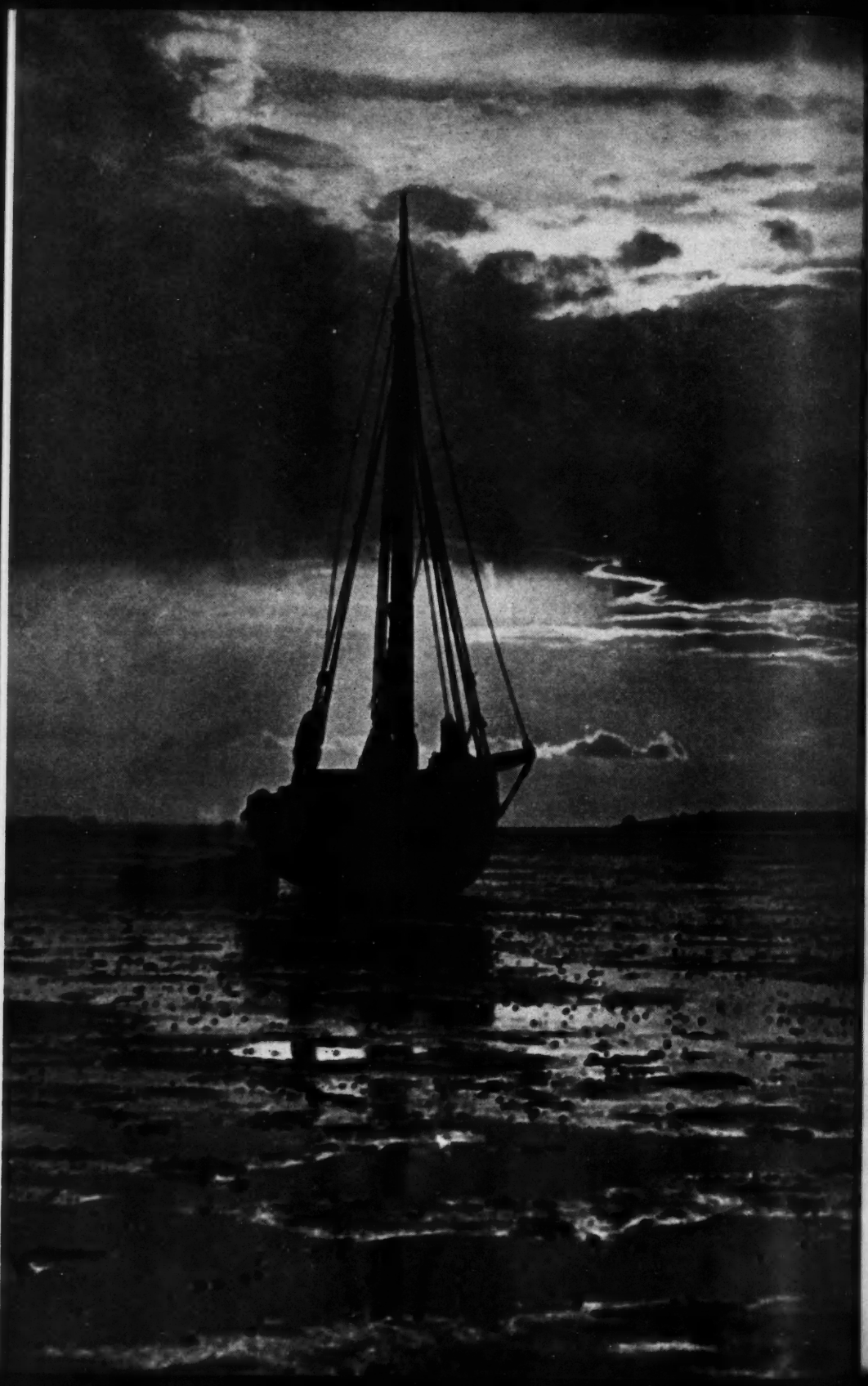
Swans and Cygnets



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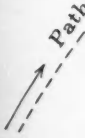

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The Turn of the Tide

By Dr R. E. D. Clark

Every now and again a would-be philosopher tells the world that rhythm is the secret of all things. And in a sense, rather a far-fetched sense it must be admitted, this is really so. For it is due to tides, if not to rhythm, that we live and move and have our being.

The solar system started with a tide. Once upon a time a passing star pulled a huge tide of flame out of the sun, part of which left the sun altogether and condensed to form the planets. Later on, so it appears, the moon was produced in a similar way, by the cooling down of a huge tide of molten rocks which had become dislodged from the earth. We do not yet know precisely how this great earth tide was produced—many astronomers think that one of the major planets must be held responsible. At all events, one thing is clear. Were it not for tides our small corner of the universe would be a very different place—indeed there would be no life at all.

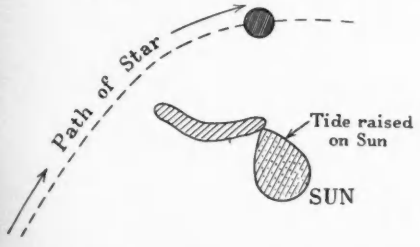


Fig. 1. A passing star raised a tide of flame on the sun. From this tide matter streamed into space and formed an object looking like a bent cigar. This condensed to form the planets.

(*Adapted from Jeffries*, The Earth, *p.* 20.)

No sooner did the moon come into being than it began to produce tides on the earth. What the first tides were like is not known for certain. In the early years of the earth's history vast quantities of steam and other gases issued from the semi-molten rocks. Soon the earth was covered with a thick layer of superheated steam, so hot that no conceivable pressure could turn it into water. It was through this steam that heat steadily escaped as the earth cooled, so that the steam must have been much colder high up in the sky than it was near the ground. At a certain height, therefore, it was able to turn to water and so, for a time at any rate, there floated in the sky a turbulent ocean heaving up and down as the moon circled round the earth.

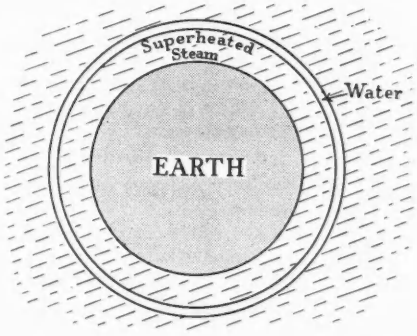


Fig. 2. At one time the earth was surrounded by an ocean suspended in the sky—an ocean which heaved up and down as the moon circled round.

How much this ocean heaved, how many feet the aerial tide rose and fell, we do not yet know, but the motion may have been very considerable. Moreover, this sea was probably very rough, not only on its top, but even more so on its bottom surface. A strange world indeed! It actually re-

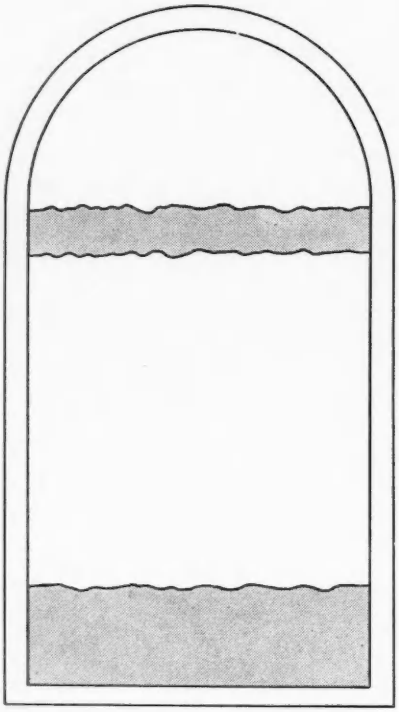


Fig. 3. *The diagram reproduced above was drawn in the sixth century A.D. by the Egyptian monk Cosmas Indicopleustes. It shows the world shaped like a tabernacle, with a second ocean high up in the sky, supported by great pillars on either side.*

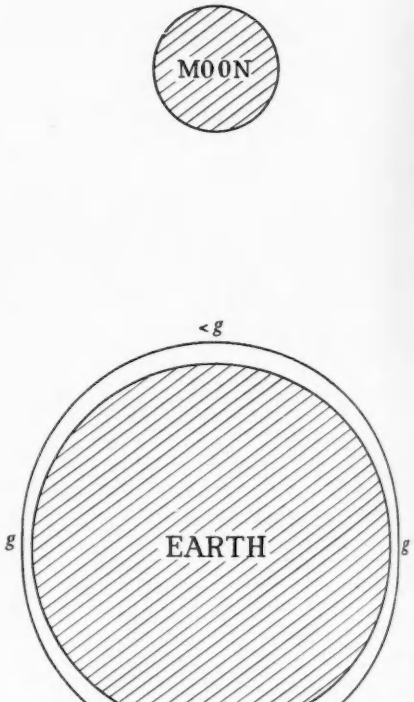


Fig. 4. *How tides are produced by the attraction of the moon* (*see Fig.* 5 *also*).

sembled to some extent the world in which our forefathers thought they lived, a world in which there was supposed to be another ocean suspended in the sky! (Gervase of Tilbury, writing in A.D. 1211, relates that as some people were coming out of an English church one Sunday morning, they saw an anchor let down by a rope issuing from the heavens. Soon they heard shouts of sailors trying to loose the anchor and finally a sailor came down the rope, but immediately he reached the ground he died as if drowned in water.) But of course we know that the old legend was quite unjustified, for there were no men on earth at the time in our planet's history when the sea was in the sky.

All this time the ocean was coming down, down, down. Finally, it reached the ground and the dry land appeared—no doubt it was rather wet at first. And since that time nothing exciting has happened to the tides, save that the moon has gone farther and farther away and so disturbs us less than she used to in bygone ages. But this is enough of ancient history. What about the tides of to-day?

We now know that the moon produces

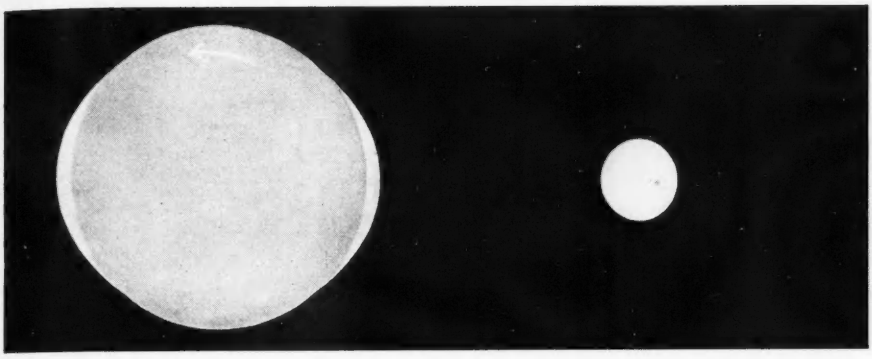


Fig. 5. How tides are produced by the action of the moon.

three kinds of tides, tides of the sea, of the earth, and of the air. Let us consider, very simply, how the marine tides are produced.

We know that the earth is pulling everything downwards, for that is why things fall when we let them go. But the moon pulls things too. So when the moon is directly above us, we are pulled downwards by the earth and upwards by the moon. This is not really so sensational as it sounds, for instead of being torn limb from limb all that happens is that we are pulled downwards with slightly less force than before. So let us write "$<g$" (less than gravity) at the top of Fig. 4.

At the sides of our figure we can now write g, for the moon is here well out of the way and has no influence on the downward pull of the earth. This means that the oceans at the sides will be pulled inwards more than at the top of our figure, so that "$<g$" stands for a high tide. Next we come to the antipodes—the point on the opposite side of the earth. Here the moon is pulling in the same direction as gravity, so we must write "$>g$" (greater than gravity) which

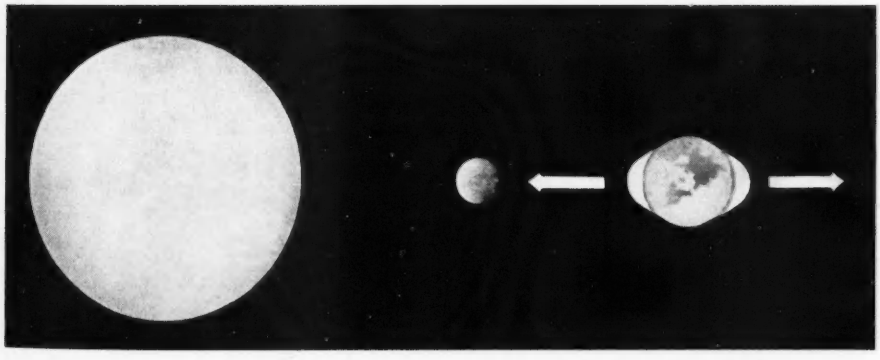


Fig. 6 It is not the moon alone which makes the tides; the sun is also partly responsible. When both sun and moon are pulling together we get spring tides.

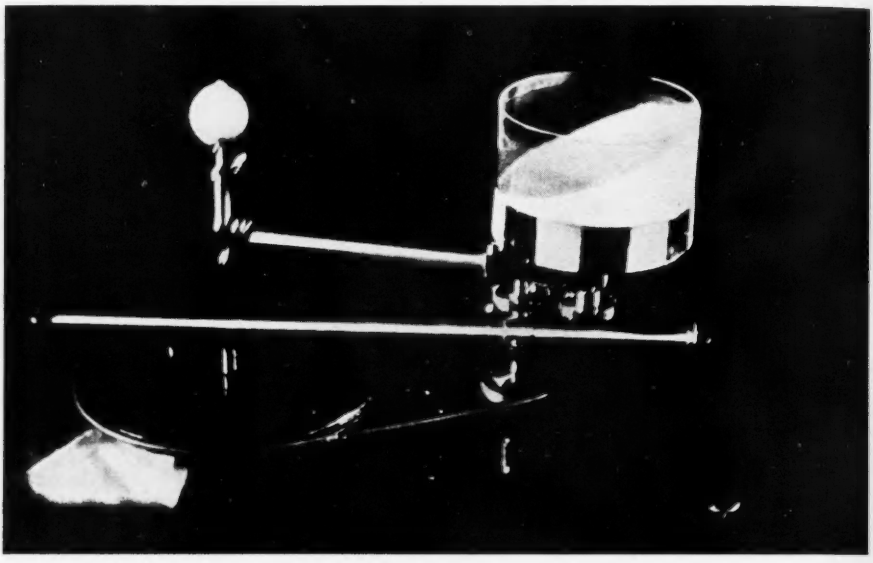


Fig. 7. The effects of the sun and moon in making the tides can be imitated by means of mechanical models in which vessels of water are swirled round—

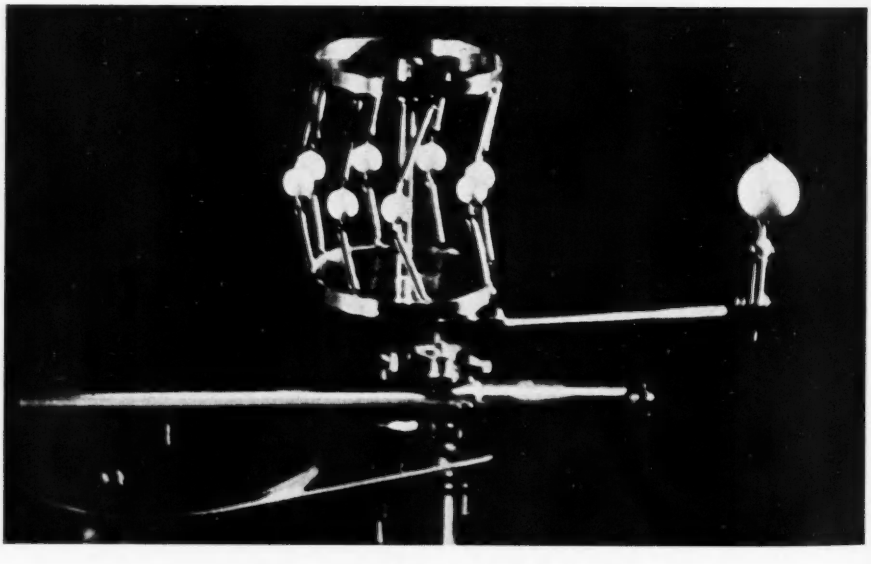


Fig. 8. —or by the use of balls on springs.

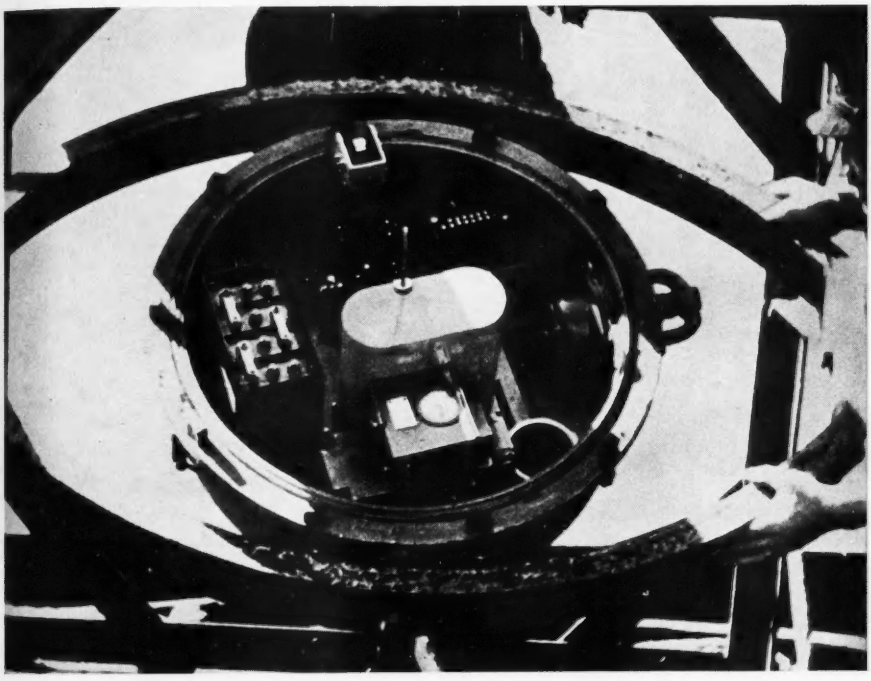


Fig. 9. An up-to-date instrument for registering the turn of the tide.

would correspond to a low tide. Yet something has clearly gone wrong, for if the oceans were pulled like this there would only be one high tide every day instead of two. Yet for some reason or other there is a tide on the side of the earth which lies away from the moon, as well as on that which lies on the same side.

The reason for this is not difficult to see, in a general way, though it needs some complicated mathematics to work it out in detail. Not only does the moon attract the sea, it also attracts the earth. So the sea which is nearest the moon bulges out because gravity has become less and the earth moves into the bulge half-way and so leaves another bulge at the antipodes.

That is the way the tides are produced. But there are all kinds of other factors at work. The sun gives tides as well as the moon, and it is when these two heavenly bodies are pulling in the same direction that we get spring tides. Again, it often happens that although the moon is overhead, there is no high tide; a point about which flat-earthists were once particularly enthusiastic! This is because the moon rushes round the earth so fast that the water cannot keep up with it—the moon pulls her hardest but the water, not being able to rise into the sky, has to wait for hours until the tidal wave arrives.

Then again, the depth of the sea has a lot to do with the time of the turn of the tide, because it is this which really determines the speed at which the needed water can arrive.

So on the whole the tides of seas and rivers are by no means simple. Indeed, scientists have almost abandoned the

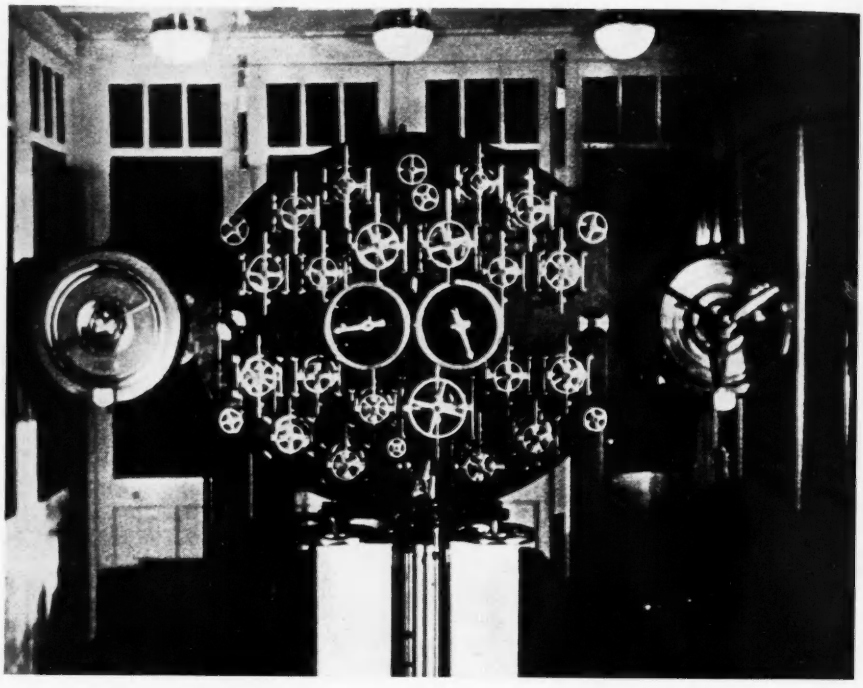


Fig. 10. *Another modern machine for recording the turn of the tide.*

attempt to calculate the tides by mathematics, and to-day they make huge models of river basins in which, by pushing the water this way and that, it is possible to find out by actual experiment what will happen when the wind blows one way and the moon pulls another. Experiments are also made with models in which the effects of the various forces at work can be imitated by swirling round vessels of water or by rotating little balls attached to springs.

There is much more that might be said about the tides—how they produce the bores or tidal waves of rivers which have sometimes been used as a source of power, how scores of marine animals adapt themselves to the rhythm of the ebb and flow of the water, and how modern instrument makers have produced machines for recording the turn of the tide. But there is no space here to discuss all these fascinating topics.

Next we come to tides of the earth. Perhaps, at one time or another, you have heard one of your friends arguing that if everything in the universe suddenly became a million times smaller, no one would be any the wiser. Now astonishingly enough something rather like this has actually been happening in human history, and your friend was quite right, no one *did* notice the difference. We have not been growing bigger and smaller, but we have been heaving up and down instead. For if all the fields and the meadows and the towns and the villages have risen or fallen a foot during the last few hours, the ordinary man would have no means of telling that anything had happened.

As the moon turns round the earth, the

great continents, and no doubt the ocean bed as well, heave up and down in unison. It was found in America that the difference between "high tide" and "low tide" might be as great as a foot and a half. This earth tide takes place because the earth behaves like an elastic solid. It is far more simple than ocean tides. There is no need to wait for waves of earth to come and raise the land, so the tide is always high when the moon is directly overhead or under our feet. Incidentally, it appears that earth tides have something to do with earthquakes—the tide releases, as it were, the trigger which starts the slipping of the strata.

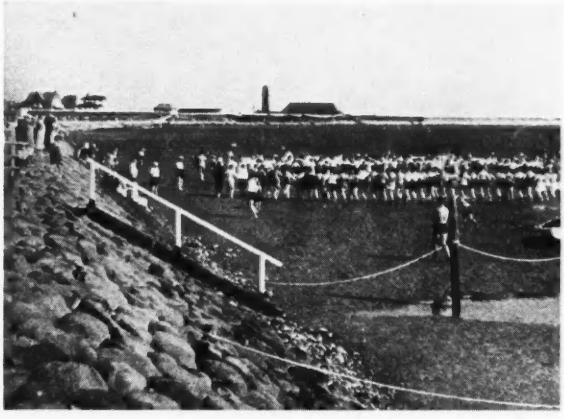


Fig. 11. *Low tide at Büsum, a German summer resort.*

Lastly, there are air tides. For a long time people thought there were no such things. The barometer simply refused to change with the position of the moon in the predicted manner, and that seemed to settle the matter.

But now at last air tides have been found. They occur about fifty miles up in the sky and they are relatively enormous in magnitude—they have an amplitude of half a mile or even a mile in height. In future years they may be of some importance, for wireless engineers depend upon the electric charges floating about at these heights to reflect wireless waves back to the earth and so prevent them going off into space.

Before we close, there is one point worth adding. We have seen that it was a tide on the earth which produced our moon and that since then the moon has never ceased worrying us with her tides. Now it seems that the sun has had a similar unfortunate experience. Long ago it produced a huge tide which in turn produced the planets, and it is supposed by some astronomers (though all do not agree) that the planets are now having their vengeance upon the sun. At all events the two largest planets in the solar system come into juxtaposition every eleven years or so, and every eleven years or so the sun has spots—possibly the result of tides. It is the old story—both the sun and the earth have been hoist with their own petards.

Fig. 12. *The same place at high tide.*

Reviews

British Birds

THE third volume of this series* deals with hawks, geese and ducks, and fully maintains the high standard of the two previous volumes. It is lavishly illustrated, and the authors express their gratitude to Mr Peter Scott for the special illustrations of all the British species of geese which he has painted and most generously presented for use in this work. They are, of course, both accurate and artistic. Also the plates of ducks in flight by Mr J. C. Harrison deserve high praise; he is the artist who paints those delightful Christmas cards published by the Norfolk and Norwich Naturalists' Society. Acknowledgement is also given to many other helpers, and use has been made of valuable biological information concerning ducks from the works of J. G. Millais and J. C. Phillips.

There are also interesting maps showing the migrations of several species of ducks, and another showing the comparative density of the heron population, which must have entailed the sifting of numerous records over a series of years. Throughout the text are inserted drawings of birds in flight and of various portions of avian anatomy which will help novices and others to identify both birds on the wing and skins in the hand. The sketch delineating the pectination of the middle claw and toe of the heron may be quoted as an example of exact knowledge. The coloured plate of the wing coverts and specula of various ducks is both artistically and biologically a fine piece of work.

To field naturalists the paragraphs on "Field characters" and "Habits" and "Voice" will appeal most. These monographs show considerable powers of vivid description, and the points emphasized in italics are most important for field identification. Those on "Breeding" will be of equal interest to oologists and other less specialized observers, and the accurate descriptions of plumage are invaluable when examining the skins of dead birds. Male ducks in eclipse are difficult to identify except when the skin can be handled. But the majority of bird-lovers to-day are more attracted by the live bird than by its carcass.

All British species are included, even those which have occurred on only a very few occasions, though these are of little interest to any but the specialist in *rarae aves*. The notes on "Distribution" are again most carefully written. Local bird-watchers, particularly in the south-west of England, will notice in this, as in the previous volumes, certain omissions. Some of these are perhaps due to the questionable reluctance of scientific ornithologists to accept records of uncommon species unless the bird is "obtained"; other omissions may arise from a commendable desire to refrain from giving too precise information to a certain type of collector. But some *lacunae* are attributable to the reluctance of field naturalists to disclose facts that would subject uncommon species to similar depredations. It is regrettable that exact ornithology should be penalized in this manner.

Many naturalists will be able to supplement the descriptions by their own observations; no bird book is exhaustive. With regard to merlins, my experience is that the female frequently (not "occasionally") takes food from the jack in the air, and I have seen the fledged young take prey in the same manner from the jack. Whinchat is in some cases their commonest prey, and common redstart can be added to the list. Merlins sometimes make a subsidiary nest, not only in sand-dunes, but also inside an old nest of crow or raven, and when on the ground in heather. I am glad that the absence of game-birds from their kills is substantiated, except for a few grouse chicks. Plucking places examined by me for many years on a grouse moor have never shown any trace of game-birds.

The kestrel's habit of consuming insects captured while on the wing, might have been mentioned, and also the heron's occasional resting prone on the ground in an attitude similar to those adopted by the purple heron and little bittern.

It is stated that "confirmation" is desirable as to the incubation period of the kite, "about 28–30 days". Unless the few remaining pairs are successfully protected against egg collectors "confirmation" is likely still to be lacking. The facts given as to the breeding status of this species, and also of the white-tailed eagle, osprey and spoonbill, make melancholy reading. Such phrases as "formerly bred, now extinct as a breeding species", "now only a rare migrant" are a pitiful commentary on British bird protection. The honey buzzard was a "formerly regular, but rare, summer resident in England...now very rare and irregular". As an ornithological authority has recently

* *The Handbook of British Birds*, vol. III, by H. F. Witherby, Rev. F. C. R. Jourdain, N. F. Ticehurst and B. W. Tucker. Witherby, 21*s*.

stated that forty were killed in one county alone before 1912, and that three were killed as recently as 1938, the reason for its rarity is obvious. The breeding of the bittern in Norfolk and elsewhere in gradually increasing numbers strikes a more cheerful note.

A most interesting observation by a well-known naturalist is quoted as to the whooper swan, viz. that at death the final expiration of air from the long convoluted windpipe produces a wailing, *flute-like* sound given out quite slowly. This surely is the real origin of the "swan-song" legend. It recalls at once Tennyson's "full-breasted swan. . . *fluting* a wild carol ere her death".

The various species of geese and the distinctions between them receive careful attention. The inclusion of the Canada goose, hitherto excluded from the British list, was long overdue. Coward included it in his *Birds of the British Isles* in 1920, and Yarrell accepted it at an earlier date.

The division of ducks into surface feeders and divers, their various plumages and displays, and the distinguishing marks on the rarer species are well described. The hint that the speculum and black and chestnut patches on the coverts of the gadwale are often concealed, though in plates they seem to afford clear identification marks, explains why its recognition at a distance is often so difficult. Similarly the coloured pictures of wigeon in eclipse will be specially useful to observers, for this plumage differs remarkably from the winter dress. "Field characters" of the pintail might have mentioned that this duck usually swims very low in the water, and the shorter tail of the male long-tailed duck in its first winter might also have been stressed; many winter visitors of this species seem to be young males. These, and other small criticisms, are not made in a carping spirit. The whole series is admirably planned and executed, and when completed will form a magnificent record of modern British ornithology.

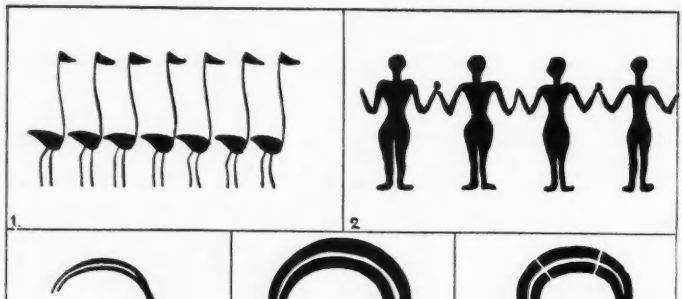
E. W. HENDY

Buried Empires

ARCHAEOLOGICAL excavation during the last fifty years, but mainly during the last twenty, has virtually doubled the span surveyed by history. More than 2500 years before the earliest reliable records of Greece and Rome hieroglyphic and cuneiform documents disclose the contributions made by Mesopotamia and Egypt to building up the cultural tradition which we inherit through classical antiquity. Yet to many educated people even Ancient History still begins with Solon and the expulsion of the Tarquins albeit prefaced by epic legend and the "sacred history" enshrined in the Old Testament. Any endeavour to familiarize the public with the earlier chapters—or rather volumes—of history, generally ignored by classicists, is accordingly to be welcomed. Mr Carleton has the advantages of a mastery of cuneiform, an accomplishment deplorably rare in Britain, and of familiarity with the lands and sites he describes. His book* deals mainly with Mesopotamia down to the middle of the second millennium B.C., but possesses the peculiar merit of embracing also the prehistoric civilization of the Indus valley, that richer contemporary of Mesopotamia, that archaeology has just rescued from complete oblivion. On the literary side the book is brought up to date by an appendix on new documents from Mari that threaten disconcertingly to upset the seemingly well-established chronology used in the text. On the other hand archaeological reports, issued during the last two years, have not been utilized, so that various statements dealing with early periods need modification; the rite of cremation, for instance, can no longer be admitted in the Jemdet Nasr phase.

I feel that the author has followed too closely classical models of historiography. One advantage possessed by very ancient history is that we can objectively distinguish what is really important for human progress. At this long range dynastic changes, wars and migrations which impressed their contemporaries overpoweringly fade into insignificance in comparison with the accumulation of cultural capital that was only temporarily interrupted or retarded by them. Mr Carleton's history tends to be too much a record of battles and lists of kings, which are important primarily for providing a chronological framework. "His" (Gimil-Sin's) "reign", writes the author, "is the least interesting of the dynasty" (of Ur), "and marks the beginning of its decline. Only two wars are recorded." Other tablets, however, exist of which "the student who is not a specialist in commercial documents soon becomes heartily sick". But they can be made to yield a surprisingly vivid picture of the economy and social organization of Sumer about 2000 B.C., more significant and far more reliable than character sketches of kings, known only by a few brief and boastful inscriptions. Mr Carleton very properly and successfully describes the architecture of temples and the rites conducted in them; he mentions only casually the economic function of these institutions as repositories of capital and their academic importance as colleges. He

* *Buried Empires: The Earliest Civilizations of the Middle East*, by Patrick Carleton. Edward Arnold, 10*s.* 6*d.*



1. Storks. 2. Female Figures. 3.4.5. Goats
6. Flight of Birds. 7. Archer. 8. Galloping Dog

Conventional designs from painted pottery and the highland culture: various sites and periods.
(From "Buried Empires")

tries to make prehistory and protohistory a sort of history in which peoples and migrations, deduced from the ambiguous evidence of pot-sherds and glyptic styles, take the place of individual actors and particular battles. In these speculations Carleton is sober and reasonable, particularly in defining "Semites" and "Aryans". Naturally he cannot mention all conflicting theories; but Dussaud's account of the Semites based upon a convincing comparison of a stela from Erech (here figured opposite p. 62) with the famous little knife-handle from Gebel el-Arak in Egypt should surely be noticed. In any case, we possess concrete and indisputable evidence for events of more lasting importance than migrations. Clay tablets from Erech disclose with unparalleled clarity the stages whereby a system of writing and numeral notation was created. This stupendous invention is passed over in a brief paragraph which is not even accurate. The author says there are traces of the sexagesimal system having been influenced by a foreign decimal system. Actually in early tablets the one system is used for measures of grain, the other for beer. Nor would any reader recognize that the symbols for units and tens are common to both the decimal and the "sexagesimal" notation; the peculiarity of the latter is that the next unit is 60 and then powers of 60 instead of 100 and higher powers of 10.

May we hope that the deserved popularity of the present volume will soon call for a new edition in preparation for which the author will both read up current reports and study Marxist literature.

V. GORDON CHILDE

Mexico in Transition

MEXICO is a strange country. Between Sonora state in the north and the isthmus of Tehuantepec, where the continent attains a width of only 140 miles, there is a wide range of customs, peoples, and scenery. There is as much difference between the inhabitants of Mexico City and of the *hacienda* as there is between the architecture of the early and late colonial periods. Everywhere, too, signs of the vanished Mayan and Toltec civilizations bear witness to the existence, long ago, of yet another Mexico. This book* touches upon all its varied phases.

Mexico is a country of problems. There is the problem of the mestizzo, of the expropriated oil-fields, of the trade-union peons, of the age-old religious strife. Mr Marett has not been drawn into any controversy over these points. In spite of the personal loss he suffered owing to the Revolution, and notwithstanding the fact that his wife is a member of the Spanish American aristocracy, he paints, with humour and restraint, as fair and balanced a picture of the country and its people as any could wish. Of particular value is the account of the gigantic experiment in collective cotton-farming at the Laguna, and of the dislocation at the Minatitlan refineries following the expropriation.

What will happen in Mexico the author does not know. There are many who hate the Calles régime, but few who will risk anything to change it. Meanwhile, the government is making an indifferent success of the "Mexicanized" properties, the agrarian movement is bringing distress to those it was designed to aid, and the financial position of the country is far from healthy. Whatever befalls, however, this is a book of historical value, which will prevail when its more highly coloured contemporaries have been remaindered.

R. W. KIDNER

Prehistoric Life

THE old-fashioned text-book was like the House of Lords; a stately body whose function lay in preventing rash innovations. Long as it often took for new theories to get into the text-books, once in, it took longer still to get them out again. Recent American publications, of which this is a worthy example,† have done a great deal to change this state of affairs. *Prehistoric Life* is quite remarkably up to date on such rapidly changing subjects as the homologies of the bones of the vertebrate skull, and shows a praiseworthy freedom from prejudice in discussing traditionally controversial topics such as the evolutionary history of the ammonites.

Another good point is the lack of the dogmatic tone which is, or was, almost universally to be found in semi-popular books on science. Such phrases as "modern research has shown..." do not occur at all, and the author often admits that he does not know, or that there are several explanations possible. This is all the more remarkable when one considers that the book covers the whole history of life, from the doubtful fossils of the pre-Cambrian to the present day. To write a history of all living things in three hundred and twelve pages is a task which cannot be accomplished without some ruthlessness, and it is to be expected that a reader who has his own preconceived ideas about some of the points discussed should get a few jolts. For example, in discussing the causes which led to the evolution of terrestrial vertebrates from the fishes, the author suggests that for herbivorous fish the habit of feeding on overhanging plants may have led them to "try to climb the banks". A little later he speaks of the "lure of atmospheric oxygen". At first sight such passages might suggest that he supported a rather crude Lamarckian idea of evolution as being the result of mental striving after higher things. The general tone of the book, however, forbids such an idea. These minor lapses are the result of lack of space: the author is saying in plain language what a more squeamish zoologist would express by a circumlocution. It is one of the advantages of a book of this type that there is no room for circumlocutions.

M. P.

* *An Eye-witness of Mexico*, by R. H. K. Marett. Oxford Univ. Press, 9*s*. 6*d*.

† *Prehistoric Life*, by Percy E. Raymond. Harvard Univ. Press, 21*s*.

The Story of the Lamp

THE history of artificial lighting dates from the time when primitive man first plucked a burning brand from his fire to dispel the shadows from the recesses of his cave or to protect himself from the prowling beast. Since that time lighting has progressed far, but it is remarkable how irregular and arbitrary this progress has been, for in ages of otherwise great activity in experimental science little change is often to be recorded, while the progress of the last few decades entirely eclipses that of all previous history. Until the middle of the nineteenth century the only practical source of light was the combustion of some fatty fuel, and according as to whether the fuel was solid or liquid were developed the essenti-

ally distinct torch, rushlight and candle on the one hand, and the oil lamp on the other. Each of these two forms of lighting had its own part to play and both have remained in constant use even to the present time. It is, however, only within the last century that any considerable improvement in either has been effected. Throughout previous history the oil lamp remained a crude wick dipped into an open vessel of vegetable oil, and although the oil containers at times developed into objects of very real beauty there was little effort to improve the fitness of the lamp for its purpose, and in fact Roman lamps with closed oil reservoirs were superior in many respects to the open lamps in use in this country in medieval times. Only at the close of the eighteenth century, when Argand devised a lamp in which the flame was adequately aerated, and the draught was improved by the use of a chimney as suggested by Leonardo da Vinci some three hundred years earlier, was any attempt made to apply practically the obvious scientific principles of combustion. These changes, together with the substitution of mineral for vegetable oils in 1848, are the only noteworthy practical advances in the history of the non-incandescent oil lamp. With the coming of gas and electricity there were made available sources of light of so much greater brightness that for the first time the problem of light control arose and the design of a lamp was no longer confined to the source itself, but extended to the reflecting or refracting system necessary to control the light. For this reason the attempts to adapt old fittings to modern needs, and the use of "electric candles" and other monstrosities, are usually failures, for without adequate control such arrangements are often displeasing and always extremely inefficient.

In *The Story of the Lamp** the history of the candle and the oil lamp is traced authoritatively from the earliest times to the present day. To the general reader the book will commend itself principally on account of the very complete series of magnificent photographs which perhaps constitutes the most comprehensive collection of its kind ever published. The text, on the other hand, must be primarily for the student and specialist, for the wealth of detail and the numerous references are reminiscent of the style of a museum catalogue: nor does the small type set in unusually long and closely spaced lines facilitate reading. The reader who is prepared to follow the author on his long journey will, however, find himself rewarded by a fascinating story of the history of the artificial lighting which adds so many hours of value to every day of his life, and with the help of which he is, perhaps, reading these words.

R. C. EVANS

* *The Story of the Lamp*, by F. W. Robins. Oxford Univ. Press, 15*s*.

Select List of Books Received by *Discovery*

(*Mention in this list does not preclude review*)

Ten Years Under the Earth. NORBERT CASTERET. (Dent, 12*s*. 6*d*.)

Eastern Journey. JOHN H. MACCALLUM SCOTT. (Travel Book Club, 3*s*. 6*d*.)

The Native Races of Asia and Europe. J. G. FRAZER. (Lund Humphries, 35*s*.)

From Hunter to Husbandman. J. W. PAGE. (Harrap, 7*s*. 6*d*.)

A Naturalist on Rona. F. FRASER DARLING. (Oxford University Press, 7*s*. 6*d*.)

Protein Metabolism in the Plant. ALBERT CHARLES CHIBNALL. (Yale University Press, 18*s*.)

Unsolved Problems of Science. A. W. HASLETT. (Scientific Book Club, 2*s*. 6*d*.)

How Life Began. DAVID FORSYTH. (Heinemann, 5*s*.)

The Mystery of the Fate of the Ark of the Covenant. CYRIL DOBSON. (Williams and Norgate, 3*s*. 6*d*.)

The Study of Society. Edited by BARTLETT, GINSBERG, LINDGREN, THOULESS. (Kegan Paul, 10*s*. 6*d*.)

The Story of the Lamp. F. W. ROBINS. (Oxford University Press, 15*s*.)

Mathematical Recreations and Essays. W. W. ROUSE BALL. Revised by H. S. M. COXETER. (Macmillan, 10*s*. 6*d*.)

Motor Racing. Edited by EARL HOWE. (Seeley Service and Co., 15*s*.)

Photographic Make-up. WRAY MELTMAR. (Pitman, 15*s*.)

Garden Bird Sanctuaries. MELVILLE NICHOLAS. (Seeley Service and Co., 15*s*.)

Floral Morphology. E. R. SAUNDERS. (Heffer, 10*s*. 6*d*.)

The Insect Legion. MALCOLM BURR. (Nisbett, 12*s*. 6*d*.)

The World of Insects. CARL D. DUNCAN and GAYLE PICKWELL. (McGraw-Hill, 21*s*.)

Analysis of Handwriting. H. J. JACOBY. (George Allen and Unwin, 10*s*. 6*d*.)